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THE POWER PLANT OF A LEAD WORKS

AS AN illustration of the application of electricity to driving modern manufacturing plants, and the several advantages thereby secured over the older and less efficient system of belt transmission, the new plant of the Raymond Lead Co., is excellent.

This is situated on Lexington Street, Chicago, on the Chicago and North Western Railroad and is the largest plant of the largest manufacturers of plumbers' supplies and mixed metal products in the world.

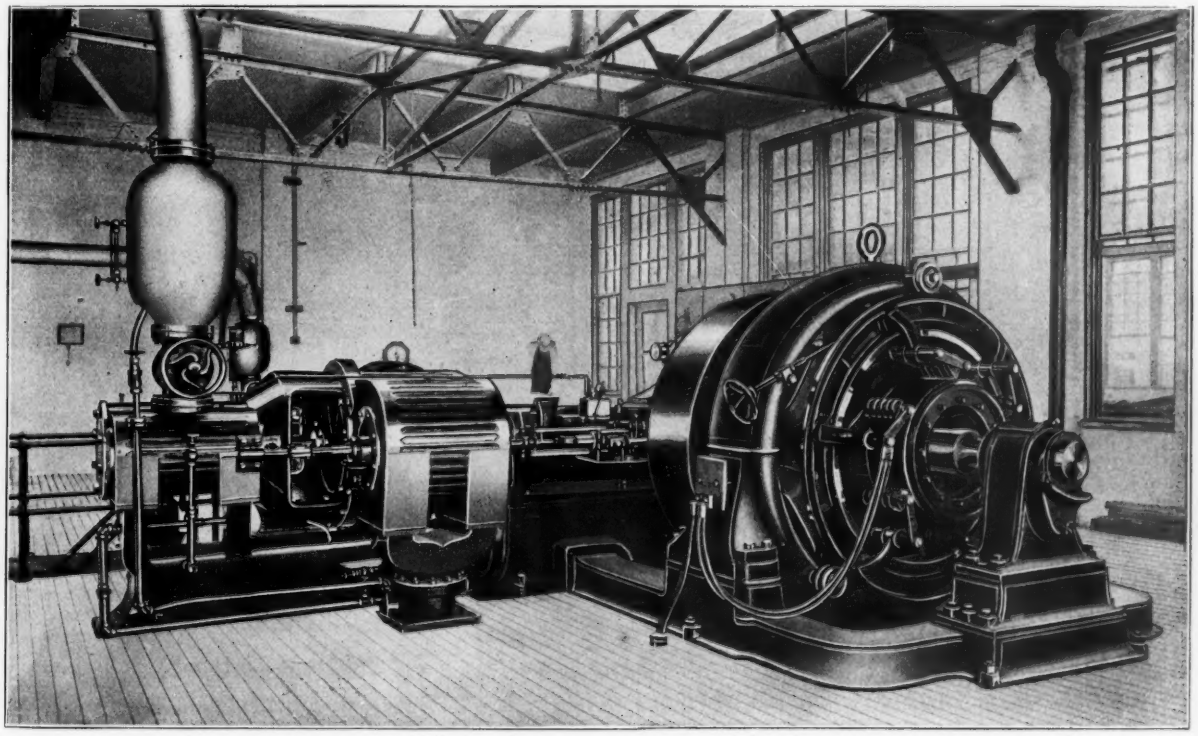


FIG. I. LARGE GENERATING UNIT. FLEMING ENGINE AND ALLIS-CHALMERS GENERATOR

Buildings

The main building is divided into 3 sections, A, B and C. At sections A and C, the width of the building is 112 ft. and the length over all is 536 ft.

The buildings are constructed of light faced brick, the roof being carried on iron trusses, with several skylights, which with many windows gives an abundance of light.

The arrangement of the various departments and machines is such that the material is handled in rotation during the several processes, until the finished product passes out at the opposite end of the building from which the raw material entered.

Processes

While the whole plant is interesting, the attention of the visitor will be centered on the sheet lead and lead pipe departments, and their output.

Lead, in the form of pigs from the smelters, is unloaded from the cars on a platform, from which it passes to the kettle, where it is reduced to a molten state. It then goes to the slab pan, where it is formed into slabs on cooling. From these pans the lead slabs

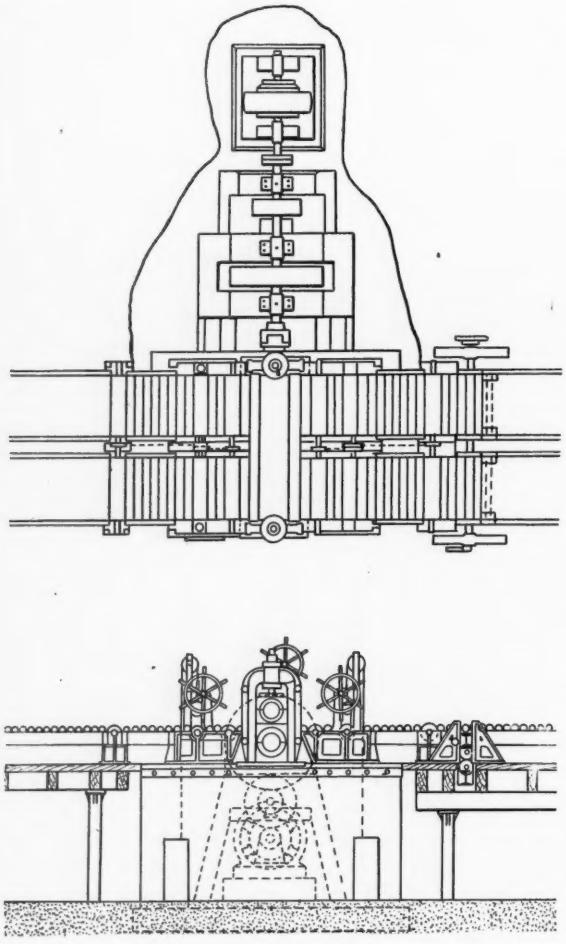


FIG. 2. DETAILS OF THE PLATE ROLLING MILL

pass the mammoth lead rolling mill, which is shown in detail in Fig. 2. This reduces the slabs to the required thickness and weight, the metal leaving the other end of the mill in sheet form. A crane carries it on "dollies" to the scales, where it is weighed and then it passes to the shipping department.

The lead rolling mill referred to above is 1 of the largest built. It is 10 ft. wide and 115 ft. long. It is driven by a 75-hp. direct current motor, direct-connected to the mill through a double speed reduction gear. One of the requirements of this service is the necessity of reversing the motor from full speed in one direction to full speed in the other direction, and this is said to be the first installation in this country driving by this method.

A brass foundry is maintained for the production of such brass parts as are required for the line of lead products turned out. A noticeable point in the foundry, is the duct from the motor-driven blower to the cupolas. In place of the usual sheet metal duct, this company has used wrought-iron pipe and fittings with the necessary valves, as a more durable equipment. The foundry contains a magnetic separator, which separates the iron and steel from the brass.

Lead Pipe

In the lead pipe department sufficient space is provided for 10 hydraulic presses, 8 being installed at present. Two 50-hp. motors are belted to a line shaft which in turn drives the necessary hydraulic pumps to operate the presses, the pressure required being 4500 lb. per square inch.

In this department, a systematic handling of the material has been arranged also. The pig lead going from the cars to the kettles and then to the presses, where it is converted into the required shape, and passes to the shipping department or store house.

To supply heat, light and power for this plant there has been provided a plant, which while not remarkable for innovations, is unusual in the provision of light and convenient quarters with abundance of room around machines and flexibility of handling.

Boiler Equipment

The boiler room is situated on the ground floor, south of the engine room with windows opening into the engine room and turret ventilation.

Coal is unloaded from the cars on the siding, and passes to the boiler room floor into the coal pocket through the coal chutes.

To supply steam at present, 2 260-hp. Parker water-tube boilers are installed, with sufficient space for the installation of another battery of 2 boilers. Figure 3 is an elevation of the boilers and stokers.

Each of these boilers has 2604 sq. ft. of heating surface, made up of 112 4-in. tubes, 20 ft. long, and 1 drum 48 in. in diameter by 22 ft. long. The drums are made of steel 7/16 in. thick and the boilers are built to carry 150 lb. pressure.

The boilers are protected from excess pressure by Ashton pop safety valves, The main stop valve being made by John Acton, Brooklyn, N. Y. The water columns are fitted with Huyette chain pull gage glass valves, and Huyette self-closing chain pull gage cocks, the steam pressure is indicated by Ashton steam gages. The blow-off pipes are fitted with 2-in. Pratt and Cady blow-off cocks and Crane angle valves.

In the Parker boiler, a construction differing from the usual horizontal water-tube boiler practice has been adopted.

In this boiler, both the drum and the tubes are horizontal. The drum is divided into parts by a diaphram running from the back head of the drum for-

ward, almost to the front head. A vertical plate secured to the diaphram, extends down to the bottom of the shell, thus forming a pocket between the vertical plate and the front head of the drum, into which the feed water enters through the front head.

There are 2 connections from the drum to the tubes. Water enters a rear header through a short nipple, passes through the top tube to the front header, then downward and through the next tube to the rear, through the rear header to the tube beneath, and so on until the lowest tube of the section is traversed. As the lowest tube is in the path of the hottest products of combustion, the water is converted into steam, and is discharged through long nipples into the steam space of the drum.

The tubes are expanded into malleable iron junction boxes, which are like return bends, each holding 2 tubes. These boxes are circular in section, and will withstand a high pressure.

As the tubes do not have to pass through the hand holes, when it is necessary to renew them, a handhole plate of the same diameter as the inside of the tube can be used.

A feature of this junction box construction is the method provided to grind the joints between the boxes and the caps.

To grind the seat bearing of the caps and boxes, the grinding key is placed in the slot in the cap provided for its reception, being held in position by a spring clip. A mixture of graphite and oil is applied to the faces, the cap being brought to its seat, and revolved by the key.

A separate plate, seating on the inside of the header, and held by a suitable dog, gives access to each tube. The boiler is composed of several sections of tubes placed side by side, and of a height and width to fit any location.

Natural draft is furnished by a Custodis chimney 5.5 ft. inside diameter and 125 ft. high.

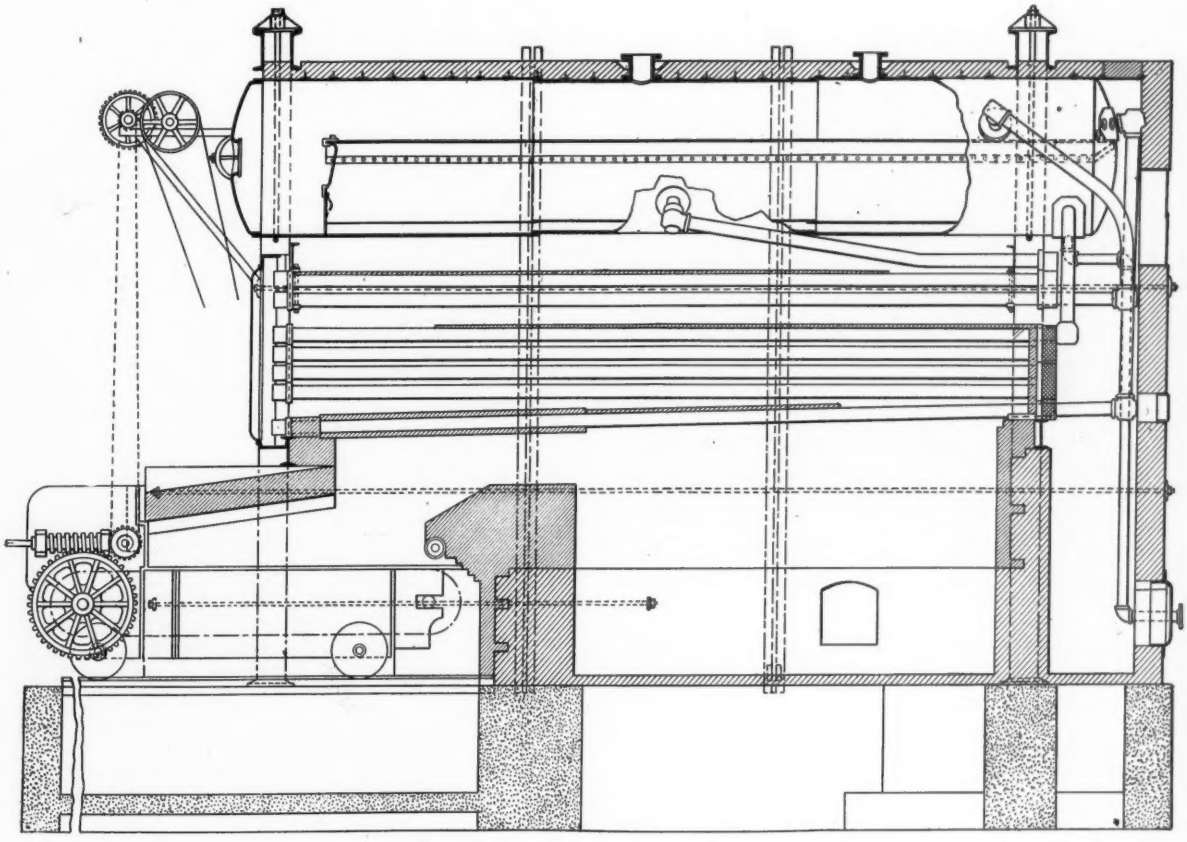


FIG. 3. SECTIONAL ELEVATION OF BOILERS AND STOKERS

The boilers are equipped with chain grate stokers, built by the Weir and Craig Mfg. Co., Chicago. A small vertical engine, made by the same company, controlled by a Gardner throttling governor, drives by a belt the stoker shaft, which is hung in suitable bearings across the boiler front. Sprockets mounted on this shaft drive a chain, and this in turn drives a worm and gear. In Fig. 4 the stokers and the manner in which they are driven is shown.

In the boiler room, located a convenient distance from the floor, a Hoppes open heater of 600 hp., made by the Hoppes Manufacturing Co., Springfield, Ohio, is installed. Figure 5 gives a view of the heater and

piping. This heater receives the exhaust from the engines and pumps, what is not required in the heating of the feed water and the heating system in cold weather passing through a Van Auken back-pressure valve and Hoppes cast-iron exhaust head to the atmosphere.

The water level in the heater is controlled by a

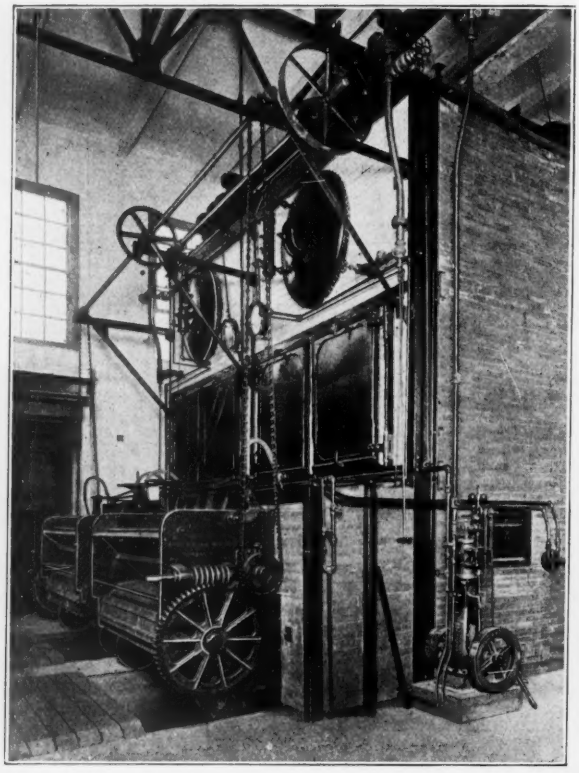


FIG. 4. PARKER BOILERS AND WEIR & CRAIG STOKERS

float, which through a system of levers is connected to the regulating valve in the city water line, the hot water gravitating to the boiler feed pumps.

In the pump room situated off the boiler room, a vacuum pump, made by the American Steam Pump Co., Battle Creek, Michigan, maintains the necessary vacuum in the heating system. Two Epping Carpenter duplex steam pumps 6 by 4 by 6 in. of the pot valve type are provided to feed the boilers. The steam cylinders are lubricated by oil pumps made by the Hills-McCanna Co., and the pumps are controlled by regulators made by T. F. Ford, of New York.

These pumps are arranged as shown on Fig. 6 so that they may draw from the feed-water heater or from the city mains and they may discharge to the boiler feed line, to the house service line or to the fire protection system. Either pump may be used on one service while the other pump is busy on another service.

The exhaust pipe line is provided with a Van Auken oil separator, made by the Consolidated Engineering Co., Chicago, for the removal of cylinder oil. The steam separators on the steam line to the engines are drained by Anderson steam traps, made by the V. D. Anderson Co., Cleveland, Ohio, discharging into the Hoppes heater, thus assisting in maintaining economy as well as protecting the engines.

Piping

The layout of the piping system is simple. From the steam nozzle on the drum of each boiler a short riser connects through a 6-in. horizontal length and

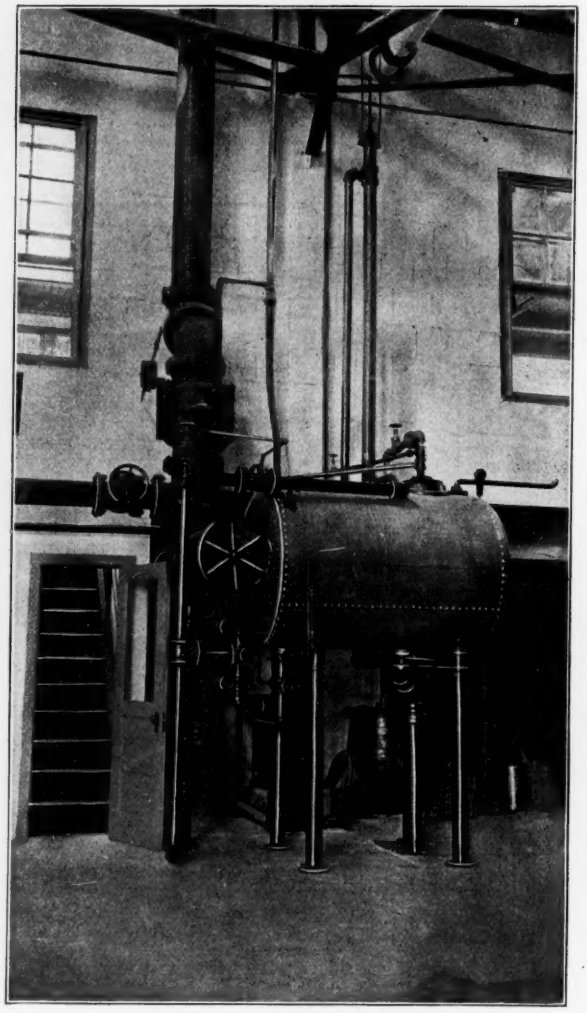


FIG. 5. HOPPES HEATER AND CONNECTIONS

Crane gate valve into the steam main which is 8 in. in diameter.

The steam line to each engine is taken from the top of the main as seen in Fig. 6, thus avoiding the possibility of carrying the water of condensation in the main to the engines.

After passing through the wall between the engine and boiler rooms, the pipe runs horizontally for a short distance, then sweeps with a long radius bend

to the separator at each engine. The steam main is drained at frequent intervals as shown in the view of the piping, Fig. 6.

A 2-in. line is taken from the steam main at the west end to supply the pumps.

system, from another outlet the pipe runs full size to the atmosphere, and from the third outlet of the tee the Hoppes heater is connected in shunt as seen in Fig. 5. The piping is carried on suitable hangers, which allow for expansion and contraction.

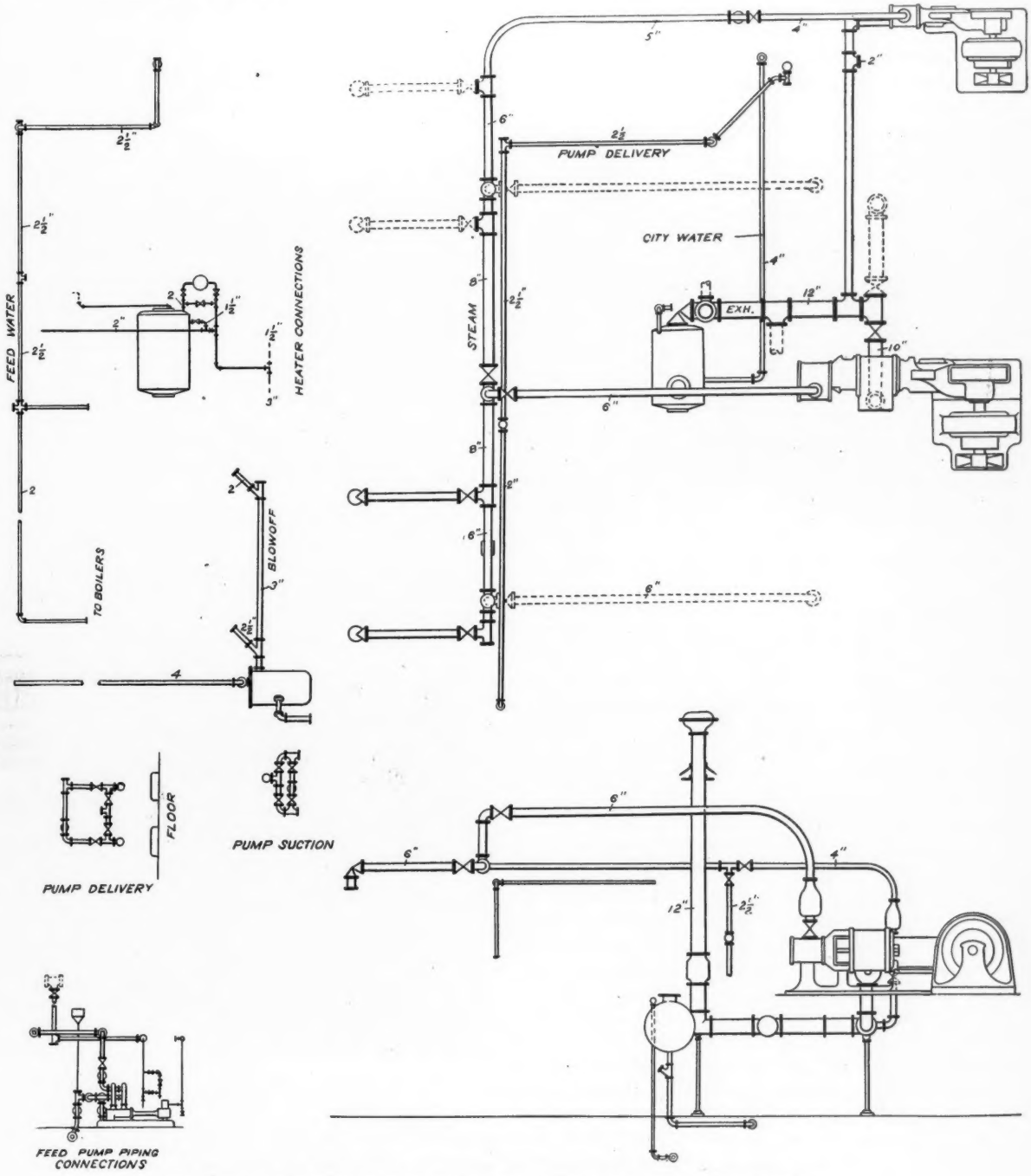


FIG. 6. PLAN AND ELEVATION OF PIPING WITH DETAIL OF PUMP CONNECTIONS

The exhaust from both engines and pumps enters a 12-in. exhaust main, which after passing through the engine room wall is connected to a tee. To one outlet an 8-in. connection is provided for the heating

Engine Room Equipment

The engine room, which overlooks the boiler room, is well lighted, with the walls finished in white, which presents a neat appearance.

To supply current for lighting and power, 2 Fleming-Harrisburg side crank non-condensing high-speed engines of the piston valve type have been installed, with room for duplicating the installation as the requirements of the plant make it desirable.

Both engines are direct connected to Allis-Chalmers direct current generators.

The smaller unit Fig. 7, has a cylinder 9 by 12 in., runs at a speed of 300 r. p. m. and is direct connected

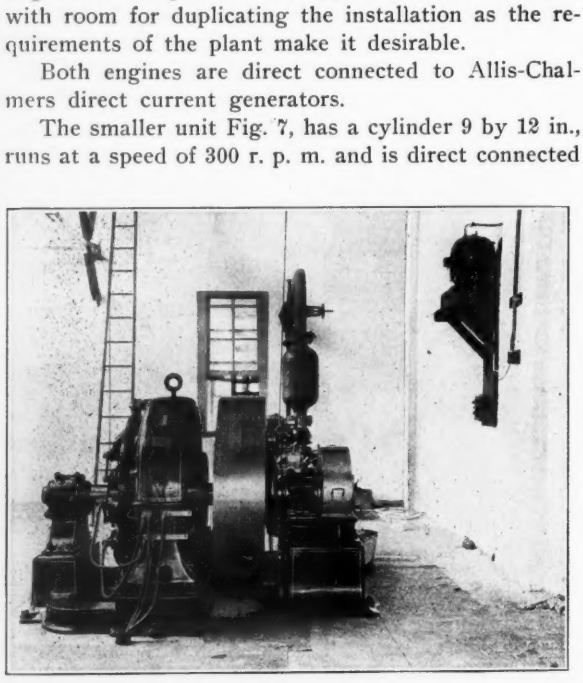


FIG. 7. SMALL GENERATING UNIT AND BLOWER MOTOR

to a 50-kw. generator. The larger unit Fig. 1, is a 15 and 26 by 16 in. tandem compound, running 200 r. p. m. and direct connected to a 150-kw. generator. The steam cylinders are lubricated by Hills-McCanna oil pumps, with Sherwood hand pumps for emergency.

Engine Lubrication

An important point in the construction of the engines is the self-oiling system, by which means the several bearings are automatically lubricated.

A reservoir is provided in the engine frame under the crank disks. Into this reservoir a sufficient quantity or engine oil is placed to wet the crank disk about 0.5 in. When the engine is running, centrifugal force throws the oil backward upon the guides crosshead and wrist pin, the crank having an ornamental cover which prevents the throwing of oil outside the engine.

Running across inside this cover is a trough, which is maintained full of oil by centrifugal force. The trough is connected to a short piece of pipe which discharges oil into the main bearing where it finds a free passage inward and the overflow drips into an eccentric groove cut in the face of the crank disk on the side next to the bearing. From this eccentric groove the oil passes through suitably drilled holes to the crank pin. The oil after passing through the various bearings, returns to the reservoir under the crank disks and is used repeatedly.

By this copious lubrication the friction losses, wear and attendance are reduced to a minimum.

These engines are provided with box beds, heavily ribbed and pleasing in appearance, and having large bearing surface on the foundation.

In the tandem compound unit, the low-pressure cylinder is connected to the high-pressure by a massive distance piece, which provides sufficient room

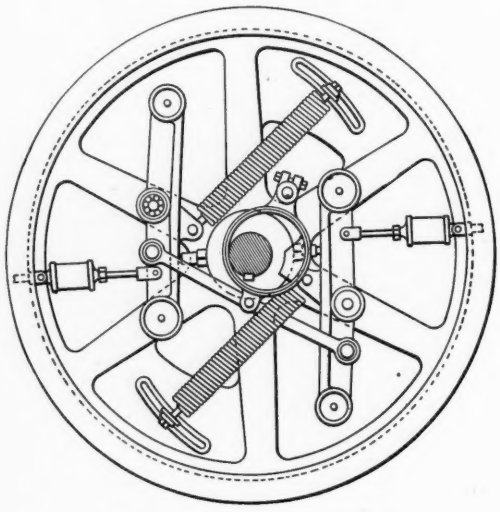


FIG. 8. FLEMING GOVERNOR

for the examination of the low-pressure piston. The high-pressure cylinder has a substantial support, which prevents all tendency to rock.

The centrifugal inertia governor used on these

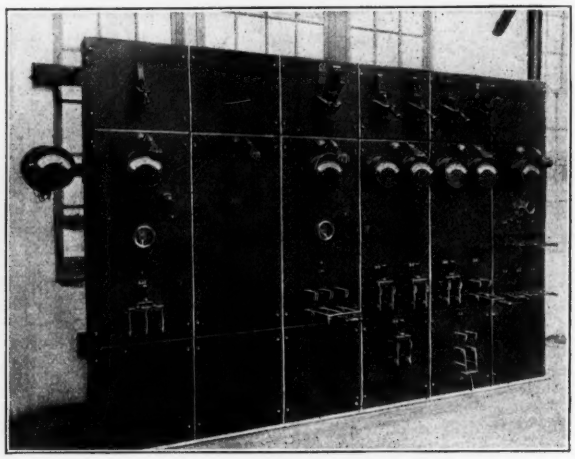


FIG. 9. THE SWITCHBOARD

engines is seen in Fig. 10. This gives exceptionally good regulation throughout the variation of load, since the governor is balanced in all positions of its working range.

Briefly the construction of the governor is as follows: Two lever arms are so located that their centers of gravity act together about the center of rotation. Two spiral springs resist the centrifugal force

of the weights, the weight levers being provided with pockets for the reception of weights to change the speed when desired.

The engines were built by the Harrisburg Foundry and Machine Co., Harrisburg, Penn.

Electrical Equipment

As previously stated the plant is all electrically driven. In many cases the several machines are driven by individual motors. Lighting circuits and power are taken from the same bus bars, the generators working at a potential of 240 volts.

The switchboard, Fig. 9, is situated in the engine room along the north wall with an abundance of space for access to the back of the board. The switchboard consists of 6 panels of black slate, 2 for generators and 4 for circuits. The several panels are provided with the necessary circuit breakers and distributing switches for the several circuits.

Mounted on the generator panels are the rheostats, main switches and circuit breakers, ammeters and a common voltmeter. All the instruments being made by the Westinghouse Electric and Manufacturing Co., Pittsburgh, Pennsylvania. By inserting a cord with suitable terminals into the proper receptacle the voltmeter can be connected to either generator.

On the extreme right of the switchboard, the several feeder circuits, on the last panel, are connected through suitable shunts and the ammeter switch to the common ammeter mounted on that panel. By this arrangement the cost of a separate ammeter for each circuit is avoided.

The whole light, roomy plant is a comfort to the operating engineer and a credit to its designer, Charles R. Guertler, consulting engineer for the company, to whom we acknowledge indebtedness for courtesies in preparation of this article.

HEATING A BUILDING BY STEAM

IN THIS article we will consider briefly, the heating of a 3 story brick building by direct radiation.

Before going into the calculations of the various details, let us examine some of the primary facts in regard to the heat required, heat lost by radiation and leakage.

Heat Required

To determine the amount of heat needed in any room or building it is necessary to find the heat radiated through walls, windows, floor and roof, and that lost by leakage of air through windows and doors.

It is assumed that the indoor temperature will be maintained at 70 deg. F., and in heating calculations, provision is made to keep the indoor temperature at that point, when the outside temperature is the lowest likely to be found continuously in a given locality. For the central states in the latitude of Illinois, this temperature is taken at —5 deg.

Experience has shown that the change of air from leakage will amount to a renewal of the air in a room once an hour. Of course this does not allow for open doors, windows or transoms, but the ordinary creeping in of air around the door and window casings.

In figuring the heat required in a building when a number of people are present, the requirement of heat needed is reduced by that given off from the body, and from the lights used. It is found that the heat given off per person per hour is about 400 B. t. u., 1500 B. t. u. an hour for each incandescent electric light and 4500 B. t. u. an hour for each gas jet.

Walls

Loss of heat through walls has been found to vary as per Table I, the values being the heat units lost per square foot of wall surface an hour for each degree difference between the inside and outside temperatures.

These figures are for a southern exposure, and should be multiplied by the following constants for the different exposures: North, 1.25; east, 1.1; west, 1.2; all around exposure, as for an entire building 1.16. For a building heated during the day only, in unexposed positions, 1.1, in exposed positions, 1.3. For buildings heated only occasionally, 1.5.

The chart p. 26, shows the heat loss from building walls with various differences of temperature. The vertical values show the heat units loss per square foot of surface per hour. The figures given on each line are the loss represented by that line per hour per square foot of surface for each degree difference in temperature corresponding to the values given in Table I.

TABLE I—HEAT LOSS THROUGH BUILDING WALLS.

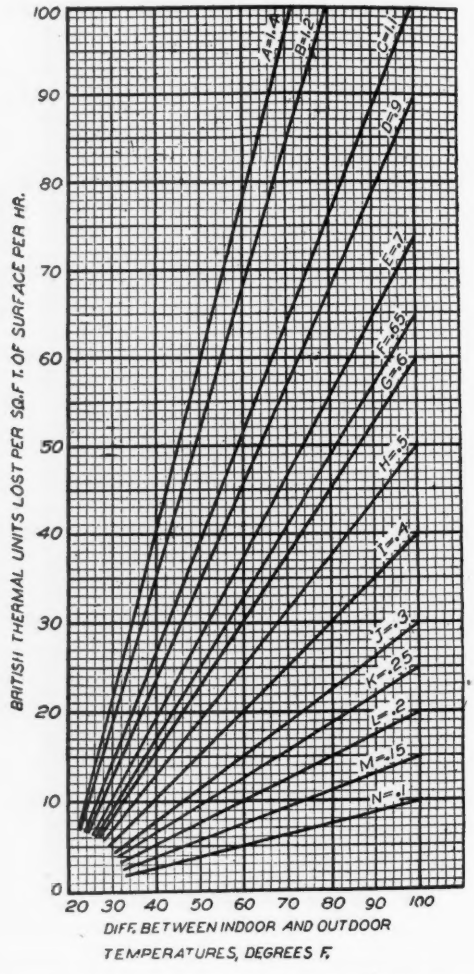
Vault lights	1.4
Single windows	1.2
Single skylight	1.2
Slate roof	1.1
Shingle roof	0.9
Brick walls, 4 inches	0.7
Double skylight	0.65
Double windows	0.6
Brick walls 8 inches thick	0.5
Brick walls 12 inches thick	0.4
Doors	0.4
Brick walls 16 inches thick	0.3
Wooden walls as ordinarly used in dwellings	0.3
Brick walls 20 inches thick	0.25
Brick walls 24 inches thick	0.2
Fireproof floor	0.2
Brick walls 32 inches thick	0.15
Double wood floor	0.1

With ordinary construction of certain classes of buildings there will be a fairly constant ratio of window surface to wall surface and the same kind of material used in the construction of all the buildings.

Again there will be a definite number of heat units given off per square foot of heating surface per hour for the different kinds of radiating surfaces.

Radiating Surfaces

The radiating surfaces required per cubic foot of contents of different classes of buildings are given



HEAT LOSS FROM BUILDING WALLS WITH VARIOUS DIFFERENCES OF TEMPERATURE

in Table II, which is based on the following:

That the radiating surface is wrought iron pipe which will give off 250 B. t. u. per square foot per hour, at a temperature of 228 deg., with the steam pressure 5 lb. by the gage: Then 1 sq. ft. of radiating surface will be sufficient for the following cubical contents: Houses and 1-story shops, 50 cu. ft. Banks, offices, and 2-story shops, 70 cu. ft. Retail stores, 100 cu. ft. Hotels and wholesale stores, 125 cu. ft. Churches and halls, 200 cu. ft.

If the building is in a severe exposure, and the wind strong and bleak, multiply the foregoing values by 1.2. If cast-iron radiators are used increase the heating surface 10 per cent.

For certain calculations the figures given in the last column of Table II are of value, and give the number of heat units given up by the radiating surface an hour for each square foot and for each degree difference when wrought iron pipe is used. When cast-iron radiators are used multiply the values by 0.9.

The most accurate method for ascertaining the amount of heat loss would be by calculating the number of square feet of wall surface in a room or building, the square feet of window surface, of floors and of ceilings, and from the heat loss given in Table I, find the total heat lost. Allowance should be made for raising the air in the room from the outside temperature to 70 deg. once an hour if there is no artificial ventilation, calculating 1 thermal unit to raise the temperature of 1 cu. ft. of air 55 deg. The result will be the amount of heat that must be supplied by radiation.

The last column of Table II shows how many heat units will be given off per square foot of radiating surface for the steam carried, from which the number of square feet of radiating surface required can be determined.

Figuring a Heating System

As an illustration, let us take the following example:

A building is 3 stories high and constructed of brick. The inside measurements are: floor 30 by 60 ft. and the height from the floor to the ceiling 10 ft. The average size of the windows is 2 by 4.5 ft.

There are 4 windows on the east side, 4 on the north, 1 on the west, and 4 on the south on each floor.

The frontage on the east is 30 ft. and 15 ft. on the north and south sides next to buildings.

How many heat units are required per hour to heat the building in the morning, when the outside temperature is zero, to 70 deg. inside?

The numer of square feet of surface in the windows is found by multiplying the area of 1 window by the number of windows.

The windows are 2 ft. wide and 4.5 ft. high; therefore the area of each is $4.5\times2=9$ sq. ft. The number of windows is 39, hence, $39\times9=351$ sq. ft. is the area of all the windows.

Since no thickness of wall is given we will assume it to be 12 in. The number of square feet of wall surface will be equal to the total wall area less the total window area.

Since each story is 10 ft. high and there are 3 stories, the height will be $3\times10=30$ ft. The ends are 30 ft. wide, so that $30\times30=900$ sq. ft. is the area of 1 end; and for the 2 ends it is $2\times900=1800$ sq. ft. The sides are 60 ft. long and 30 ft. high, which equals $60\times30\times2=3600$ sq. ft. The area of the roof will be $30\times60=1800$ sq. ft. The total wall area being the sum of the above, or 7200 sq. ft. The number of square feet thus found minus the number of square feet of window surface will equal the net wall area. We therefore have $7200-351=6849$ sq. ft.

The cubic contents of the building is found by

multiplying the area of the base by the height, this equals 30×60×30=54,000 cu. ft.

The outside air is supposed to be 5 deg. below zero, and we will heat the building to 70 deg. inside, which means a temperature difference of 70+5=75 deg. between the inside and outside.

From the chart it is seen that at 75 deg. difference in temperature the loss per hour for each square foot of glass surface is 92.5 B. t. u.; and for 351 ft. it is 92.5×351=32,467 B. t. u.

For the brick wall it will be at 75 deg. difference 28 B. t. u. per square foot, or for 6849 sq. ft. it is 6849×28 =191,772 B. t. u. As the nature of the roof is not specified we will assume it to be a tarred roof, with the same radiating capacity as a shingled roof. Therefore the number of square feet area of the roof, 1800× 62=111,600 units. The total loss is the sum of the several losses and equals 335,839 units.

TABLE II. SQUARE FEET OF RADIATOR SURFACE PER CUBIC FOOT OF CONTENTS OF BUILDING

ABSOLUTE STEAM PRESSURE IN POUNDS	KIND OF BUILDING					B. T. U. PER SQ. FT. AN HR. W'T. IRON COILS
	HOUSE AND 1 STORY SHOP	BANK, OFFICE & 2 STORY SHOP	RETAIL STORES	HOTELS AND WHOLESALE STORES	CHURCHES AND HALLS	
0	0.0338	0.0243	0.0169	0.0136	0.0085	147
5	0.0298	0.0213	0.0150	0.0120	0.0075	167
10	0.0270	0.0193	0.0135	0.0108	0.0068	185
12	0.0250	0.0179	0.0125	0.0100	0.0063	199
14	0.0234	0.0167	0.0117	0.0094	0.0059	213
16	0.0221	0.0158	0.0110	0.0089	0.0055	226
20	0.0201	0.0144	0.0100	0.0081	0.0050	248
25	0.0182	0.0130	0.0091	0.0073	0.0046	274
30	0.0169	0.0121	0.0085	0.0068	0.0042	295
35	0.0157	0.0113	0.0079	0.0063	0.0039	317
40	0.0148	0.0106	0.0074	0.0059	0.0037	338
45	0.0140	0.0100	0.0070	0.0056	0.0035	357
50	0.0132	0.0095	0.0066	0.0053	0.0033	377
60	0.0121	0.0087	0.0061	0.0049	0.0030	412
70	0.0112	0.0080	0.0056	0.0045	0.0028	447
80	0.0104	0.0075	0.0052	0.0042	0.0026	479

Since there are no persons in the building and no lights lighted, the heating system must supply the 335,839 units per hour to maintain the desired temperature of 70 deg. inside.

Amount of Heating Surface Required

The amount of radiating surface required to heat the rooms to the desired temperature is next to be found.

From a steam table it will be seen that the difference between the temperature of the room and the steam which is assumed to be at 5 lb. pressure gage, is 157.95 deg.

The surface required to supply a given amount of heat is equal to the number of B. t. u. required, divided by the difference in temperature, between the steam and the room, multiplied by a constant which varies with the kind of radiator. For cast iron it is 1.45, for wrought iron pipe 1.68; for pipe coils 1.94.

We will assume that wrought-iron pipe is used, so our constant is 1.68. The number of square feet heating surface required will be 335,839÷(157.95×1.68)= 1265 sq. ft.

From Table II the radiating surface per cubic foot of contents at a steam pressure of 20 lb. absolute for an office building (which we will assume the building considered to be) is 0.0144. This last figure multiplied by the cubical contents of the building equals 0.0144× 54,000=777.6 sq. ft. required. This takes no account of natural leakage of air.

Since 1 B. t. u. will raise 1 cu. ft. of air 55 deg. it will take 75÷55=1.36 B. t. u. for each cubic foot heated and per hour will require 1.36×54,000=73,440 B. t. u. The last column of Table II gives as the heat per hour per square foot of coil surface at 20 lb. absolute, 248 B. t. u.; hence, the surface required would be 73,440÷248=296 sq. ft. The total by this method would then be 777.6+296=1073.6 sq. ft., which is in reasonably close agreement with the amount as found by the first method.

Boilers

If a cast-iron sectional boiler is to be used, it is good practice to assume a combustion of 5 lb. of coal per square foot of grate surface per hour.

This with an efficiency of 60 per cent will be equal to 8000 B. t. u. per pound of coal consumed for useful work.

In the direct system of steam heating it is necessary to supply the heat loss in radiation, so the required grate area is equal to the computed heat loss divided by 8000, which equals the number of pounds of coal burned per hour. This divided by 5 will give the required grate area.

The total heat loss is 335,839 units, and this÷ 8000=41.78, the number of pounds of coal consumed per hour; and 41.78÷5=8.36 sq. ft. of grate area necessary.

The rating of tubular and water tube boilers is in horsepower so a little different calculation is necessary to find the required horsepower of these types of boilers.

The required horsepower equals the total heat loss per hour divided by 33,330, the number of heat units in 1 hp.-hr.

This gives 335,839÷33,330=10.76 hp.

RETROSPECTIVE OF THE DEVELOPMENT during the past year of the steam turbine, the accompanying figures reported by the Westinghouse Machine Co. are interesting as tending to controvert the general impression that the turbine business suffered heavily during the year. Although 1 month's business in 1906 still holds the record at 62,100 kw., the year 1907 was marked by an average demand quite as large. As late as July, orders for 34,750 kw. were taken during that month as compared with 25,750 for July, 1906, which is a particularly gratifying showing. For the first nine months of each year the demand for turbines was as follows: 1907, 158,550 kw., and for 1906, 152,400 kw. Or, taking the middle 6 months of the year, from April to September inclusive, thus excluding the usual midwinter activity, as well as the late depression, the average per month is as follows: 1907, 15,833 kw.; 1906, 14,365 kw.

CONNECTING WATER COLUMNS

By P. E. Merriam

MANY engineers and steam fitters, in putting up piping, do not give the connection of water columns the degree of thought and consideration that its importance deserves. From observation and experience I venture the following suggestions:

Pipe connecting columns and boiler should never be smaller than 0.75-in. for the smallest boilers and for medium and large boilers should be at least 1.25-in., in all cases made of brass so that it will resist corrosion. Fig. 1 shows the general appearance of the usual column and Fig. 2 the ordinary connections of the boiler.

Steam and Water Connections

The lower or water connection should be made at a point to permit of reaching through the front handhole with the hand to see whether the pipe is becoming stopped with sediment. This low connection is not likely to give more chance of clogging than when connected higher up, as is confirmed by experience with bad water.

The upper or steam connection should be run independent, to the highest part of the head or shell. The only connection that ought ever to be made to it being the steam pipe of the damper regulator in plants containing only 1 boiler. Should other connections be made, the draft of steam would reduce the pressure on the top of the water in the column, causing it to rise and give a false indication in both gage cocks and glass. The damper connection has no draft. In plants having more than 1 boiler this damper connection is made to the steam main so as to control all the boilers.

Effect of Stoppage

If any obstruction appears in the connections to the column the action will be as follows: If the steam connection is closed, which is rarely the case, water would at once rise as far as the obstruction in both glass and column by reason of the pressure being removed on the top while it remains on the bottom. Gage cocks and glass would all show full of water.

Should the water connection be stopped, which is quite common, water will remain stationary in the column while it may rise or fall in the boiler, and the gage cock would be unable to reveal the true level. In this case, if the lower gage cock is blown out, the water level in the column will fall and will not return to its normal position.

Should the steam valve or connection to the water glass be closed, the water would rush by to such stoppage and the glass remain full, but in such a case the gage cocks would show the true level. If the water connections be obstructed the water would remain stationary in the glass on account of the pressure remaining on top, but the cocks would again give the true level. In time the condensation from the steam end of the glass would fill the glass.

Valves

This brings us to the fact that the direction of circulation in a water column is undoubtedly downward, due to eddy currents in the water connection and aided by the condensation passing downward from the top connection and the top of the glass. The writer believes heartily in the use of valves in the two connections, although he is aware that many object to their presence on the ground that they are a source of danger. This is admitted, but when we consider the skill and intelligence required to care for, manage and secure the best results from a boiler, the persons interested should be able to see that the valves are not interfered with and are open at all times when they are supposed to be, even to the extent of locking them there if necessary.

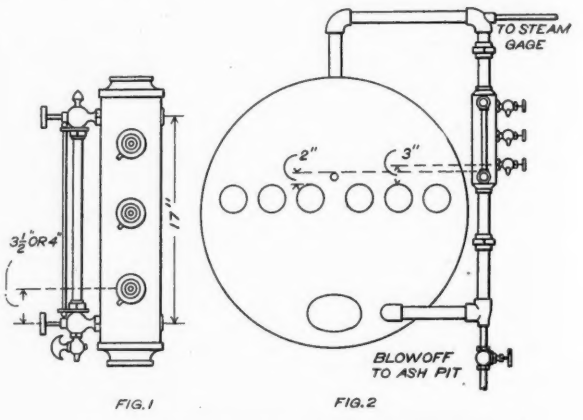


FIG. I. USUAL FORM OF WATER COLUMN

FIG. 2. ORDINARY CONNECTIONS OF COLUMN TO BOILER

Blowing Down

It is an admitted fact that when connections are made as in Fig. 2, and a blowoff valve from the column is open to blow out any accumulations that may have collected (and remember that these accumulations are looked for in the lower water connections), the steam rushing downward with great velocity acts as a knife cutting off by far the greater part of the water, sediment, etc., that should come from the lower pipe to make the blowing out effective.

When good or fair water is used the results are not so bad, but with bad water this blowing can be done to much better advantage by closing the top or steam valve, allowing the full pressure and area of the pipe to blow all obstructions out of the water connection. Be sure, however, to open both valves after blowing down, and do not forget to blow steam and

water ends separately, whether the column has valves or not, because the openings to the fittings are small and offer a good chance for sediment to lodge.

Usually the drip cock, supplied at the bottom of the glass, has an opening not over ⅛ in., which, to the writer's mind, is much too small to secure the best results. I would remove the fitting, insert a nipple or bushing if necessary, then a ¼-in. valve, draining the same through a pipe below or to the ashpit.

Repairing Connections

Frequently the nipple connecting the union at the bottom of the column to the pipe leading to the boiler,

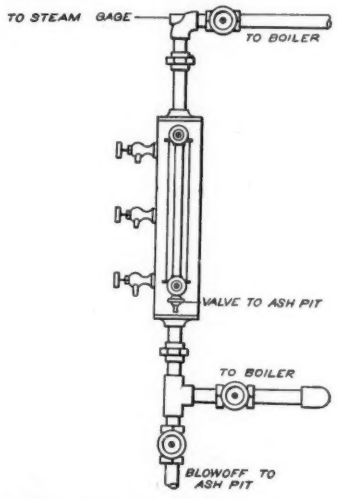


FIG. 3. SUGGESTED FORM OF COLUMN CONNECTION

or some other fitting gives out when under pressure. While it is a simple and short job to renew this, the boiler must be shut down and the contents blown off to make the repair, which takes much valuable time and in case of a single boiler plant necessitates shutting down the plant. If the column has been fitted with valves in the connections, any broken part is much more readily renewed, to say nothing of avoiding the mess made by hot water on the floor.

Gage cocks frequently leak and look unsightly when in this condition, staining the boiler front, the walls and the floor. How easy it is to renew them by closing the valves when such are provided. This can be done during working hours, and thus overtime avoided, allowing the engineer more time for self-improvement.

Location of Safety Plug

Boiler insurance companies and many state ordinances require the boiler to be supplied with fusible or safety plugs to give warning and prevent greater damage from low water. The location of this plug depends on the size of the boiler and oftentimes on the boiler maker's notion. For large and medium sized boilers it is best placed 2 in. above the top of the top row of tubes in the back head. It is the custom with many engineers, and the directions accompanying several makes of safety alarm columns state that the lowest gage cock should be placed 3 in. or so above the top of the top row of tubes, ignoring the position of the water glass and plug. Since the water glass is a great convenience, it is depended upon almost entirely to indicate the water level, and its position should be given consideration in the setting of the column.

In the common size of column 21 in. long, 3 to 3½ in. from one cock to another and 3.5 in. from center of lower glass connection to center of lowest gage cock, it will appear that when the safety plug is placed 2 in. above the highest tube and the lowest cock 3 in. over tubes, that 1 in. of water is allowed over the plug, or 3 in. over the tubes when water is at the lowest cock. Since the lowest gage cock must be covered with water to prevent the plug melting when the column is connected, as above mentioned, a greater height must be carried if the glass is to be used, since the distance from the lowest cock to the center of the glass fitting is 3.5 to 4 in., which would make the fitting below the plug, so that when water shows in the glass the plug would be bare. Therefore, the better method is to locate the column at such a height that when water is seen in the glass the plug will be safely covered; then, since the gage cocks are mounted higher in the column, they will be all right.

Should there be any thought that this method would put the column so high that when water is at or near the third gage cock it might be carried over to the engine, a shorter column could be purchased, or a column suited to a smaller diameter, thereby preserving the relation to the column, mounted a trifle higher than usual practise; although this would not be necessary in the majority of cases, as the third gage is not considered a proper place to carry water when running, for several reasons. Many plants are put in the hands of night watchmen whose duty includes caring for the boilers. In this case the watchman can allow the water level to rise after the engine is stopped without danger. Of course, there are cases where columns are connected too high and cause trouble.

One of the first things to do on taking charge of a plant is to ascertain the location of fusible plug and height of water glass lower connection and height of lowest gage cock over plug. Be governed accordingly in handling the boiler, and when opportunity presents itself change the connections, if necessary, to agree with the foregoing principles.

DON'T draw your intake air to the compressor from a hot engine room or from any point where dust is abundant. The volume of air delivered by the compressor increases proportionately as the temperature of the intake is lowered and grit entering the compressor, clogs the valves, cuts the cylinder and generally impairs the efficiency.

GAS ENGINES AND PRODUCERS

DO GAS ENGINES NEED ENGINEERS?

By W. L. Weber

I READ an article in the July number of Practical Engineer under the above title and also studied the indicator cards that were presented with the same article. The title attracted me more than any thing else, and after reading the article, I have been impelled to write on the same subject, but now that I have actually started to do so I find I have so much to say that I feel "choked up" and don't know what to mention first.

I'll start out by declaring myself as being of the opinion that gas engines need engineers, that they need good engineers, and that good gas engine engineers are mighty hard to get.

I discovered this quite recently in this way. A very good friend of mine said to me, "Billy, you said you were looking for a position, and I heard that they wanted a man of about your caliber at the Atlantic Refining Co., at Point Breeze, Philadelphia, Pa., to operate some gas engines of the Koerting type. You're just the boy for the job."

Well, I jumped on the train at Boston and went to the place mentioned, and met the manager, who looked me over and seemed to like my appearance. He took me through the engine room and it was then that my past successes as a steam and electrical engineer, also an owner of an automobile of no small dimensions, together with a newly established record as a gas (automobile) engineer, faded away. I was a babe in the woods. Do gas engines need engineers? Well, if you had been in my boots about that time you would have thought they did.

I had heard a gas engine agent tell all about how the particular engine that he was selling, required only the attention of the janitor while he was taking a rest, etc., etc., but I tell you that your Uncle Bill resolved to absorb some more things in the way of information immediately after he left that genial manager of the refining company. And I did it too, and I am doing it right along, when it comes to gas engines.

The average steam engineer doesn't understand the gas engine, and the gas engine salesman tells the steam engineer's boss that if he would install a gas engine he would not need an engineer. The steam engineer doesn't know that this is untrue and he gets his hammer out at once, because "self preservation is the first law of nature" and he isn't going to lose his job if the court is awake.

The fact is, if the engineer was posted he would see the fallacy of the statement, and would understand that, if he installed a gas engine outfit, he would have a far better grip on his job than what he has now. But he must be posted on the gas engine before he attempts to pose as an advisor of what engine to select because, even at this time, there are many gas engines made which are not reliable, and without reliability economy amounts to very little.

In the gas engine we had efficiency, but at first we did not know how to construct the machine. As an illustration, a steam engine cylinder and piston are put together with the tool marks still visible, while a gas engine must have the inside of the cylinder and the rings on the piston so smooth that the mixture of gas and air which is contained in the cylinder can be compressed to a pressure high enough so that it may be ignited and exploded. Right here is 1 principle that the steam engineer must learn and remember; that any ignitable gas mixture can be so highly compressed that the temperature resulting from the compression of the gas into the smaller space will cause explosion without any ignition device. So, the higher we compress the gas the easier it can be ignited and exploded.

The gas engine piston assumes the same relation to the cylinder that a bullet does to a gun; but the gas engine "bullet" is fastened to the crank shaft and can go only so far after the cannon has been fired. The cannon being a rapid firing machine, the thing has to be water jacketed to keep it cool or the "bullet" will stick in the cannon.

It's just exactly as Mr. Jones said in his article, gas engines do not need attention half as much as they need management. A gas engineer has to work with his head more than with his back; and you will agree that there are two classes of us; one is strong in the head and weak in the back, while the other is strong in the back and weak in the head.

More has been accomplished in the east as regards the installation of the gas engine in isolated or private plants than has been accomplished in the west. Why that is I really don't know except perhaps that the gas companies sell their gas on what they term the "step system," which means that they charge a certain price per 1000 ft. of gas until the consumption reaches a certain quantity, when the price is a certain amount less for that "block" of gas, and the plan reaches on and on in a manner that makes the consumer and the gas company both satisfied. I note that in Chicago (my good old home) they are restricted by law from doing this, and until the law

is changed it will result in the restriction of the use of the gas engine.

Filene's department store in Boston put in a gas engine outfit and is having grand success with it. The heating of the building is accomplished by exhausting through closed heaters and circulating the hot water with pumps through the heating system in the building. The Boston Herald has a large gas engine plant also and, if an operating steam engineer stood at that switchboard and saw the fluctuation of the load, he would be a surprised boy. A trip through the steel mills in the Pittsburg district, and another through the big steel plant at Buffalo, would make you "sit up and take notice," and you would get the same feeling that I have, namely: look out or the gas engine will run over us.

Do gas engines need engineers? Write a letter to some corporation which has gas engines and say you are a gas engineer, giving a good line of your (assumed) experience and knowledge of the gas engine; see how long before you will get a reply, and see what kind of a reply it will be. You will think that gas engines need engineers and no mistake. Don't ever expect to become a gas engineer if you are in the habit of doing "sloppy" work, for you never will make a success of yourself if you don't do good work around a gas engine.

Write to a lot of the makers of gas engines for their catalogues and read them thoroughly, and the very things that are set forth in these catalogues are the things you ought to know. One dollar's worth of stamps will get you nicely in touch with what is going on. Send stamps for the mailing of the catalogues. Don't try to deceive the gas engine manufacturer into thinking you want to buy. That's one thing the gas engine nor anyone connected with it, will not stand for,—deception; it's too blooming real, and you have to treat her right or else she won't run,

There is little use of discussing or writing about the various kinds of gas engines here. If you are interested, you can get books on the subject that will teach you the difference between a 2 and a 4 cycle engine and familiarize you with the parlance of the gas engineer. If you go into it remember one thing —there are a lot of bluffers in the business and, if you are not careful, you might get a "bum" lot of information.

Be careful and learn for yourself why you should select a certain type of engine for a certain kind of work or a certain kind of place, just the same as you have already learned why you should select a certain kind of steam engine for a certain kind of place or duty. There is less mystery in the gas engine when you get well into the subject than there is in the steam engine. I'm a steam engineer and I think I know.

I want to give you a tip now before I quit, and maybe the tip will put you right some time. Both the gas companies and the electric lighting companies have large mains lying in the streets. These mains are practically idle during the daylight hours, as compared to the carrying capacities. In other words, the gas mains and the electric light mains conduct but a small amount of gas or electricity during the day time; besides this, both companies have large plants connected to these mains that represent money invested. This money invested, as well as the money invested in pipes and wires, is also practically idle during the daylight hours. The gas companies want gas engines to consume their product and the electric companies want to dispose of theirs.

If the operating engineer uses gas engines with which to manufacture his own current, he can usually get it for less money than he would have to pay the lighting company. It behooves the lighting company's engineer to fight the gas engine and if the gas engine does go in, to reduce the rate after the engine has been installed and get the consumer of gas to quit the gas engine. If all the gas companies consolidated with the lighting companies in the various districts I think that it would be a grand thing for the gas engine.

In conclusion I just want to make one comment on Mr. Jones' article. He reproduces a lot of indicator diagrams from gas engines and tells us of 1 automobile garage that had an engine and an expert who took care of the engine; then he gives us a copy of the card he took. I am more afraid of the gas engine expert than a country horse is of a trolley car, and especially the expert found in automobile "garbages," and I'll bet that this was the first time that this expert ever saw an indicator. Just think of how much of a start the operating steam engineer has because he is familiar with the use of an indicator. There are a thousand and one reasons why the steam engineer had better stay away from the ball games and get busy.

GERMANY RECEIVES CREDIT for being most thoroughly scientific, and does with her limited natural resources what younger nations will soon be compelled to do in self-protection; she conserves them. When our wood supplies, stored up from 100 to 500 years, are within sight of their end, and sawmills, that have been moved from the white pine belt of the north to the yellow pine belt of the south, have been moved to the Pacific coast for their last stand, then Germany's scientific forestry policy will receive better recognition.

It must be with the crop of trees as with the crop of wheat, one crop to succeed another. If it takes 50 years to raise a tree of a given species, then 1/50 of the forest may be cut each year, provided it re-seeds or is replanted—and the sawmill will stay at the same place and the workmen live in their permanent snug homes near by; the "lumber shanty" will be a thing of the past.

A CONDENSING ENGINE usually takes about 25 times the weight of steam condensed for cooling water.

GAS ENGINE AND PRODUCER GUARANTEES*

By Prof. C. E. Lucke

IN NEGOTIATIONS between builders and purchasers of gas engines and producers it has been the custom to introduce a guarantee of performance expressly covering certain important items, such as horsepower capacity, efficiency, fuel consumption per unit of output, degree of regulation, workmanship and material and items involving the general questions of their adaptability to service and reliability.

In the course of my practice it has been brought home to me rather forcibly that these guarantees are often so loosely written that they fail to express precisely what was intended, and what is more important, indicate the professional need for an accepted mode of procedure and interpretation of terms. The following illustrations, clipped from some old contracts, will serve to call attention to the need of action on this question.

Engine Capacity

A statement of engine capacity involves a correct definition of the output of the engine in terms capable of being checked by test and in simple language that cannot be misinterpreted. A few examples will be given for illustration.

Form A—This engine is to be capable of developing 100 b. h. p.

This would seem at first glance to be clear and definite, yet as a matter of fact it is not, because, first, the engine in question was direct connected to a generator and was without any means for determining the brake horsepower, except by figuring back through the generator efficiency, which involved a calculation based on somebody else's data not verifiable; and second, it makes no provision for overload. Is the engine to be capable of delivering just 100 b. h. p., or is there implied in the common usuage of the term "horsepower" a certain excess? What is the length of run which determines the horsepower capabilities of an engine? It might seem that if an engine gave a required horsepower for 1 hour, it would be capable of doing so for 2, 3 or 4 hr., or a week; yet, as a matter of fact, the engine, being new, might run hot at the end of the first hour. In that case, has the engine proved itself incapable of delivering 100 b. h. p.? Furthermore, there is no kind of gas specified. An engine which might deliver 100 h. p. on natural gas probably would not deliver over 80 h. p. on weak producer gas. There is no speed mentioned beyond the fact that in another part of the contract it reads that the engine speed shall be 100 r. p. m. If the brake horsepower has been obtained satisfactorily with 90 r. p. m. has the engine failed?

Form B—This engine, when running at the normal speed of 100 r. p. m. with gas containing 125 B. t. u. per cu. ft. will develop 900 b. h. p.

This would seem to be better, inasmuch as it fixes a certain speed and a certain calorific power, but as practically all the gases used as power fuels contain some hydrogen, there will be a difference between the calorific value by the calorimeter and the heat actually available in engines of this class with hot exhausts. The gas supplied might have a calorific power with the high value greater than that specified and the low value lower. Has this engine then failed? Or has it fulfilled its guarantee? The time element for the run would seem to be covered in the following:

Form C—We guarantee this engine to be capable of developing 500 i. h. p. for a period of 3 consecutive hours, at the specified rate of speed, operating on producer gas of good quality, manufactured by the Dawson gas producer, and containing not less than 125 B. t. u. per cu. ft.

Here the indicated horsepower is specified, but in tests of such engines there will be differences in the indicator cards, often as great as 10 per cent, for which no provision is here made, and it becomes a matter of arbitration to decide what is a fair average card. Furthermore, it is to be noted that in this, as in Form A, the capabilities of the engine are guaranteed and not the actual performance. It would seem that if an engine can show a certain mean effective pressure, and will run, it is capable of giving a certain horsepower at a certain speed, whether it ever did so or not. There are also in Form C three definitions of the gas. It is to be good; it is to be the kind made by the Dawson producer; it shall have 125 B. t. u. per cu. ft. In an actual case, however, these may be somewhat contradictory.

The altitude at which an engine is to run will affect its capacity, as will also the pressure at which the gas is supplied, and the temperature of the gas. The following, Form D, is somewhat better in this respect than those preceding.

Form D—The gas supplied to the engine is to be producer gas of approximately 125 effective B. t. u. per cu. ft., when figured at 62 deg F., and 30 in. mercury, and shall be free from injurious amounts of tar, dust, sulphur, and other foreign ingredients. The gas is to be supplied to the engine at a pressure not exceeding 0.5 pound per sq. in. by pressure gage, and not less than 4 in. pressure by water column, and at a temperature not exceeding 100 deg. F. Revolutions per minute at normal load, approximately 150. Altitude above sea level, approximately 500 feet. Under the above conditions the normal rating of the engine will be 500 b. h. p. The engine will, however, be capable of developing 15 per cent overload for a period not exceeding 2 hr.

*From a paper before the A. S. M. E.

The foregoing contains as an indefinite element the quantities of tar, dust, sulphur, etc., elements which are injurious, without defining how much of each shall be considered injurious.

Producer Capacity

In what terms shall the capacity of producers be defined? Shall we rate producers in terms of horsepower? Evidently not, because they do no work. It might seem proper to rate them in terms of the horsepower of the gas engine that can be driven from the producer gas, but as the rate of gas consumption of different engines is different, this would make the capacity of a producer dependent upon the efficiency of an engine, which is obviously unfair. The real function of a gas producer is to gasify coal, and it might seem advisable to define its capacity in the quantity of coal it can gasify within proper limits, or in terms of the volume of gas, or the quantity of heat it can produce in the form of gas. Such is the intention of the following, Form E.

Form E—We guarantee this producer to be capable of gasifying 400 pounds of good quality No. 1 buckwheat anthracite coal per hour.

As this particular producer was operated by a steam jet blast, the coal consumed by the boiler should, in all fairness, be likewise specified. Furthermore, what is good quality No. 1 buckwheat anthracite coal, and for how many hours will the producer keep up its rate of production? The time element becomes important, because some producers will not run more than a few days without cleaning and others will continually get hotter and have to be relieved of load to cool off. There is, moreover, no provision in this form for overload or excess capacity. Form F gives a different mode of defining producer capacity.

Form F—The producer is rated at 200 h. p. Normal capacity, 20,000 cu. ft. of gas per hr. Maximum capacity, 30,000 cu. ft. of gas per hr. The producer is designed to operate on anthracite coal, coke or charcoal in sizes which will pass over a ⅜ in. screen. The gas leaving the producer will be cool, dry and free from injurious amounts of tar, dust and other foreign matter as required for gas engine purposes. It will have an approximate heating value of 125 B. t. u. per cu. ft. measured at 32 deg. F. and 30 in. barometer.

How free of injurious matter must a gas be as required for a gas engine? We all know that one form of engine is capable of operating with more dirt than another, and which one is here meant? How are the cubic feet of gas to be measured and at what pressure? Meters for this purpose are very costly, are proverbially inaccurate, and who should supply them in case they are to be used? The calorific power of the gas is not stated as the high or the low value, as pointed out in discussing the case of engine capacity, and the horsepower and gas capacity may, in a test, conflict.

Engine Efficiency

The guarantee of engine efficiency involves, in addition to the guarantee of capacity, one of input energy. The following forms, G, H, I and J, are expressions having this end in view and are written after the subject of engine capacity has been guaranteed so that references to load imply that previously specified in these clauses.

Form G—It is guaranteed that the above engine shall not require to exceed 10,000 B. t. u. per b. h. p. per hour on full load when running on Dawson producer gas and not to exceed 15,000 B. t. u. of the above gas when running on half load.

Form H—The quantity of gas containing not less than 125 B. t. u. per cu. ft. consumed is guaranteed not to exceed 80 cu. ft. per i. h. p. developed per hour, or not to exceed the amount produced by the Dawson producer from 1 lb. of best quality No. 1 buckwheat anthracite coal. The engine in each case operating under full load.

Form I—We guarantee that the engine specified in the foregoing will produce the brake horsepower stated, with a consumption of British thermal units in the form of gas, not exceeding 10,000 B. t. u. (low heat value) per b. h. p. per hr. when operating at full load provided the gas contains no more than 14 per cent hydrogen, 0.01 grams of tar per cu. m. and 0.03 grams of dust per cu. m. The British thermal unit value of the gas may range from 120 B. t. u. to 145 B. t. u., but should be kept as constant as possible.

Form J—We guarantee that this engine shall develop the brake horsepower when operating at full load with a gas consumption equivalent to 10,000 effective B. t. u. per hr., and at half load it will require 15,000 effective B. t. u. per b. h. p. per hr. and the fuel consumption at intermediate loads will be proportionate.

In these forms for engine efficiency no radically new conditions are introduced, because the input energy of an engine involves the output of the producer, and the same elements of indefiniteness previously pointed out are here repeated. Does Form I imply that at zero brake horsepower the heat consumption will be 20,000 B. t. u. per b. h. p. per hr.? Evidently this must be infinity.

Producer Efficiency

The defining of producer efficiency involves, besides the output or capacity rating in terms of gas, or heat in the form of gas, its input energy in the form of coal, and perhaps steam, if it be a steam cooled producer. The following Form K is one very commonly met with.

Form K—We will guarantee this plant, when operating on good quality No. 1 buckwheat anthracite coal, to deliver gas in quality and quantity equal to an average of 10,000 B. t. u. per pound of coal gasified in the producer. We guarantee this gas to contain 125 B. t. u. per cu. ft.

This fails to define the coal. It fails to define input

energy in the form of steam or coal burned to make that steam; it also fails in providing for the measuring of the gas energy by cubic feet and British thermal units per cu. ft. under proper limits. It is a good example of a guarantee that it is practically impossible to check by test because of the difficulty in measuring the coal in addition to the lack of gas meter pressure.

It may seem a simple matter to measure the coal fired to a producer in pounds per hour as fired, but it is not a simple matter to measure the coal gasified. Many producers contain a weight of coal and ash combined equivalent to over 20 hr. regular supply. The problem of finding the coal consumed, or judging it from the coal fired, involves the determination of the condition of the bed before and after the run. In boiler practice it is usual to make a run of about 12 hr. when coal measurements are involved. If it be assumed that the grate will contain at any one time as much coal as would be fired in ½ hr., this means that the length of run is 24 times as long as it takes to fire one grateful. If, in the producer, the bed contains 20 hr. supply, or the equivalent of 20 hr. regular firing, then the same degree of accuracy would require a length of run of 24×20 hr. or nearly a month, which is never made.

Regulation

It is often a requirement of regulation that it be good enough, or proper for the service, as for example in Form L.

Form L—We guarantee that these engines will operate the herein mentioned generators (60 cycle alternator) in parallel without cross-current in excess of good steam engine practice.

Such a guarantee as this is very indefinite, and its fulfillment is more a matter of opinion than of scientific definition or test measurment. A more common form of regulation guarantee, in terms of per cent, is given in Form M, and a still more complete form of the same general clause is given in Form N.

Form M—Between no load and full load the mean speed variation shall not exceed 3 per cent either way from the normal speed for all reasonable and usual changes of load. In case of unusual and sudden large changes of load the speed may momentarily exceed these limits, but will not exceed the limits of safety.

Form N—The required regulation, under this contract, for each of the above engines, is that the total variation in speed, due to change of load shall not exceed the following percentages. From no load to rated load, not to exceed 5 per cent; from quarter load to rated load, not to exceed 4 per cent; from half load to rated load, not to exceed 3 per cent; from three-quarters load to rated load, not to exceed 2 per cent. When running on a continuous fixed load, the variation is not to exceed 1 per cent above or 1 per cent below normal speed. It shall be the privilege of the builder to require that the official test for determining whether each engine conforms to the above guarantee shall not take place before each engine shall have been in operation 30 days.

These last two forms are defective, inasmuch as there is not common acceptance of the meaning of the words "revolutions per minute" and the mode of measurement.

What is a usual change of load, and when is a change of load sudden? How long a time is implied in the word "momentary," and what is a limit of safety? These are all extremely indefinite and such lack of definition holds a possibility of dispute and law suits. How are the revolutions per minute to be determined? Are the revolutions to be counted for 1 min. or counted for 5 min. and divided by 5, or counted for 0.1 min. and multiplied by 10? All of these modes of measuring will give different results for the revolutions per minute.

Perhaps I have said enough to make it clear that in some existing guarantees of gas engines and producers there is a deplorable lack of definiteness; a prevalent tendency to guarantee in terms of units that cannot be measured, or which are extremely costly to measure, or which may be measured in several ways without defining which one is implied.

Out of all this apparent confusion there are several simple and direct ways, and the selection of one as the solution of the problem is, first a question of definition of terms with limiting conditons, and secondly, one of mutual agreement to accept such definition.

In raising this issue, it was the purpose of the author to arouse the interest of the gas power section of the society and obtain views from its members on the subject. Aside from this, it would be of interest to hear from readers of the Practical Engineer along this line.

GAS FROM A WORTHLESS COAL*

A FORTHCOMING bulletin of the United States Geological Survey will contain an exhaustive report of the tests conducted at the Fuel-Testing Plant in St. Louis, Mo., and Norfolk, Va., on the gas producer. An interesting feature of the report will be the behavior of a certain bone coal from West Virginia in the producer. This fuel was considered of little or no value for steam boiler work, yet showed considerable value in the gas producer, developing at the engine a brake horsepower per hour for 1.65 lb. of coal.

This coal was delivered on the producer platform in lump form up to 8 or 10 in. in size. The coal crusher not being available at the time, the large lumps were broken with a hammer. The character of the fuel was rather peculiar; some of the lumps consisted almost entirely of what appeared to be a high-grade bituminous coal, others seemed to be nothing more or less than rock, heavy, hard, and when hit

*Published by permission of the Director of the United States Geological Survey.

in the dark with a hammer numerous sparks could be readily seen. And again there were many lumps of this rock-like substance to which adhere much good coal. In the producer all of these lumps, when not too large, would burn entirely through.

The fuel had no tendency to clinker or coke and worked exceedingly well, needing scarcely any poking. It was very high in ash, about 45 per cent, thus causing the ash bed to increase in thickness rapidly, which fact throughout the test, was not properly appreciated; consequently much of the time during the test the ash bed was too high for best results.

The fact that the coal had to be broken by hand, and that it was unusually hard and rock-like, resulted in lumps of coal much too large being charged into the producer. These large lumps, very high in ash, did not burn entirely through; as soon as the burning was well started, a layer of ash formed around the lump, interfering with the combustion of the remaining portion, and before it had time to burn it had passed out with the ashes unconsumed.

Because of the general appearance of the coal, but little was expected of it, and the test was started with only partial load. After several hours' run, however, the results warranted full load on the engine. After 39 hours of full load the accumulation of ash in the producer caused a little trouble; the gas went down in heat value and it was necessary to reduce the load to about 9 per cent of full load. After much grinding down of the ash bed and special care in breaking up the lumpy coal, the gas began to increase in heat value, and at the end of the test the producer was again in shape to maintain full load at the engine. The calculations for the test are based on the 50 hours taken from the time full load was carried by the engine, and for this period the gas averaged 144 B. t. u. per cubic foot, with an average load of 97 per cent of full load.

The following is the result of the test on the West Virginia bone coal:

Proximate analysis of the coal:

Moisture	0.47
Volatile matter	8.83
Fixed carbon	46.96
Ash	43.74
	100.00
Sulphur	0.27

Composition of gas by volume:

Carbon dioxide	9.7
Carbon monoxide	19.5
Hydrogen	16.6
Methane	1.6
Nitrogen	52.6
	100.00
Duration of test, hours	50
Coal consumed in producer, as fired, lb. per hr.	378
B. t. u. of coal as fired	8566
Standard gas per lb. of coal consumed in producer cu. ft	44.1
Efficiency of conversion and cleaning gas	74.1
B. H. P. developed at engine, based on an assumed efficiency of 85 per cent for generator and belt	228.8
Coal per brake horsepower-hr.. developed at engine, lb.	1.65

A NEW PLANT FOR PUMP BUILDING

In 1848 Downs & Co. established at Seneca Falls, N. Y., a small stone shop employing about 25 men for the purpose of building pumps. In 1852 S. S. Goulds, now president of the Goulds Mfg Co., became connected with the business, and for more than half a century its development has been due to his initiative and ability. In 1864 the company was incorporated under its present name and various additions were made to the works until 1870, when a fire destroyed the plant, resulting in rebuilding on a larger scale.

Additions have been made during the past 30 years until the company now employs more than 1,000 persons, and occupies over 500,000 sq. ft. of floor space and manufactures over 1500 kinds of pumps from the small bucket variety to the water works pumping engine with capacity of 5,000,000 gal. in 24 hours. The new foundry just erected is 500 by 144 ft., of pressed brick construction with monitor roof. It has 3 cupolas and a track by which ladles are distributed through various avenues. For large castings the heavier ladles are transported by a 20-ton crane serving the center bay, which is 64 ft. wide. A brass foundry 120 by 40 ft., a rattling room 42 by 160 ft., and two pattern storage buildings each 82 by 42 ft., are auxiliary to the main foundry.

Hydraulic elevators driven by Goulds pumps which are in turn driven by Crocker-Wheeler motors, serve the different buildings. Washrooms and lockers are provided for the men; all buildings are heated by American Blower Co.'s fans and a complete system of piping for the supply of compressed air and water about the plant is provided. Steam and exhaust piping and the Holly return system were installed by the Walworth Mfg. Co., Boston, Mass., the pipe covering installations by the H. W. Johns-Manville Co.

In the power plant are installed two 24 by 36-in. Allis-Chalmers heavy duty engines driving 300-kw. Westinghouse direct-current generators, steam being supplied by four 150-hp. Babcock & Wilcox boilers. The chimney is of radial brick 5 ft. inside diameter and 125 ft. high, built by the M. W. Kellogg Co.

The feed-water heater is a Cochrane and the pump equipment is, of course, Goulds, the boiler feed pump being a 4 by 6-in. triplex, the fire pump one of 1000 gal. capacity and the pump for the main water system an electrically driven 8 by 10-in. triplex.

Goulds Mfg. Co. has also eercted a new office building during the past year at a convenient distance from the works and facing the western extension of the main street of the town.

ELECTRICAL MACHINERY AND APPARATUS

VOLTAGE DROP IN DIRECT CURRENT LINES, A GRAPHICAL METHOD

By R. W. Stovel and N. A. Carle

DETERMINATION of voltage loss in transmission is a simple but most frequent operation in power plant calculations. The rule is: Volts lost = Current in Amperes × Resistance in Ohms, or E = C R. But to use this one must have a table giving the resistance of different sizes of wire, and the wire table, together with the rule, are conveniently embodied in the accompanying chart.

for weather-proof insulated wires for open work and for rubber covered wires for concealed work are indicated on the diagram by lines cutting across the lines representing the wire sizes.

Above the higher limit representing weather-proof insulation wires for open work, the wire sizes are dotted to indicate that the carrying capacity allowed by the code has been exceeded.

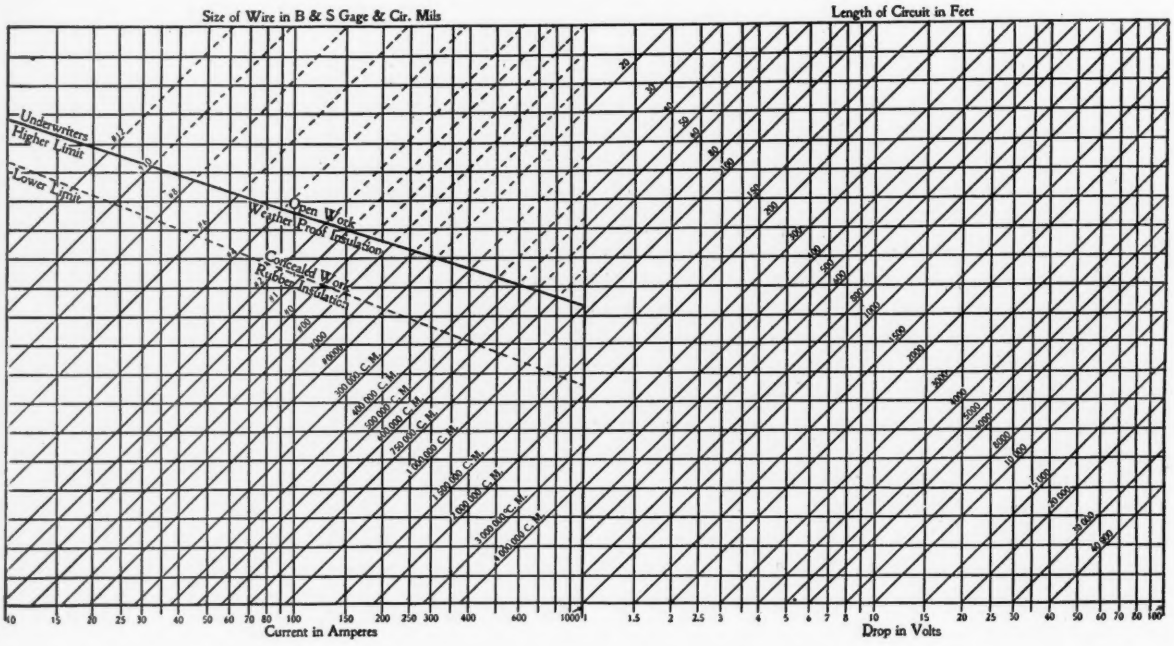

Size of Wire in B & S Gage & Cir. Mils
Length of Circuit in Feet
Underwriters Higher Limit
Lower Limit
Open Work Weather Proof Insulation
Concealed Work Rubber Insulation
Current in Amperes
Drop in Volts

CHART FOR DETERMINING WIRING FOR DIRECT CURRENT LINES. 75 DEG. F.

The diagram is capable of being read with sufficient accuracy for all practical problems and is of sufficient range to include all ordinary work. In determining drop in conductors, it should be remembered that great accuracy is labor lost, as the current is seldom known within 10 per cent of an exact value and the temperature is seldom considered, although a difference of 45. deg. F. causes a 10 per cent variation in resistance. Furthermore, it is necessary to choose between commercial sizes of wire which vary by more than 10 per cent.

The diagram is designed to read directly the volts loss for different amounts of current transmitted over various sizes of wires of different lengths. The carrying capacity allowed by the National Electrical Code

Example 1

How many volts would be lost in transmitting 300 amp. over a circuit 5000 ft. long, using a cable of 400,000 circular mils?

Start at 300 on the "Current in Amperes" scale and pass upward to the intersection of the diagonal for 400,000 c. m.; then to the right to the intersection of the 5000 line which is Length of Circuit; then downward to the "Drop in Volts" scale and the drop is found to be 40 volts.

To find the smallest wire allowable on this circuit and the volts loss, pass from 300 amp. upward to the "Underwriters' Higher Limit" line and No. 0000 is the wire found. Pass from this intersection to the

right to the 5000 ft. line and then downward, and the drop is about 77 volts.

Example 2

What is the volts loss in transmitting 50 amp. on open weather-proof wiring, 100 ft., using smallest wire permitted?

For 100 ft., the length of circuit will be 200 ft. Start with 50 amp. and go upward to the Higher Limit line, which gives No. 6 wire as the largest within the limit. Then go across to the right to the 200 ft. line and down, which gives about 4 volts drop.

Example 3

What is the proper size wire for open work for 10 volts drop on a circuit 600 ft. long and what current can be carried?

Start with "Drop in Volts" at 10 and pass upward to the 600 ft. diagonal line; then to the left to the Underwriters' limit, which shows a No. 000 wire. Then pass downward to the "Current in Amperes" and find about 260 amp.

Example 4

What distance can 80 amp. be carried, with 8 volts drop, in accordance with the National Electrical Code, using weather-proof insulation on open work?

Starting with 80 amp. read up to No. 4 wire, which is within the Underwriters' higher limit, then extend a line horizontally from this point to the right until it intersects the vertical line representing a "Drop in Volts" of 8. The intersection falls between the lines representing 300 and 400 ft. length of circuit. The location of this point is approximately 0.9 of the space between the 300 and 400-ft. lines, so that 390 ft. can be taken as the approximate length of circuit to give 8 volts drop.

Example 5

Would the rules of the National Electrical Code permit the use of a No. 00 wire for carrying 200 amp. and what would be the drop in voltage on a circuit 1000 ft. in length?

Starting with 200 amp. read up to No. 00 Size of Wire. This intersection occurs between the limits for open and concealed work, therefore this size of wire is allowable for open work, but for concealed work a No. 0000 wire would have to be used. For open work read across to the right from the intersection of the vertical line through 200 amp. and No. 00 wire to 1000 ft. Length of Circuit and then down vertically to the base line where a drop of approximately 16 volts is indicated.

For concealed work, read across to the right from the intersection of a vertical line through 200 amp. and No. 0000 wire to 1000 ft. Length of Circuit and then down vertically where the drop will be found to be approximately 10 volts.—The Electric Journal.

A THIN FIRE lightly and frequently renewed is the most economical. Do not allow coal to accumulate on the dead plate of the fire doors.

BAD ELECTRICAL DISTRIBUTION

By C. R. McGahey

IN A new plant containing good direct current machines driven in pairs from a central line shaft, which in turn was driven by a large Corliss engine, a faulty distribution system caused a heavy loss which might easily have been avoided.

The equipment was all good; the 4 generators

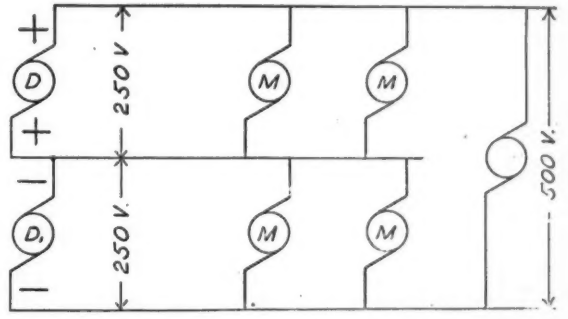


FIG. 1. THREE-WIRE SYSTEM OF DISTRIBUTION WITH STEADY BALANCED LOADS

were driven in pairs furnishing current at 250 volts for motors in various parts of the city. The 250-volt circuits being used exclusively for power. Some of the leads are carried to a great distance from the station with a large drop in electromotive force and heavy loss of energy.

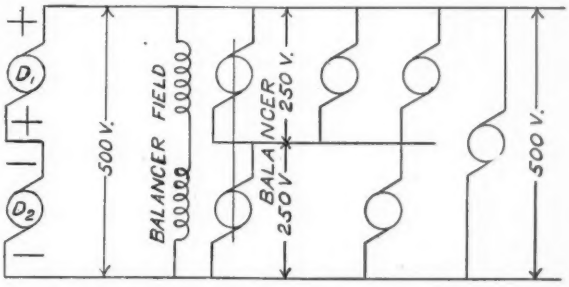


FIG. 2. THREE-WIRE DISTRIBUTION WITH LOCAL NEUTRAL AND BALANCER

Many of the factories supplied are close together so that a 3-wire distribution could have been used, saving much of this drop and loss. In such case, there would be 250 volts on each side and 500 volts between the outside wires so that a considerable saving might have been made in the cost of the wires, or a much lower drop secured.

These small and continued losses are the ones that count large in the end. With 250 volts from outside wires to neutral and 500 volts between outside wires, either 250-volt or 500-volt motors could be used, Fig. 1. As the motors were mostly of the same size and the factories near together, the load could easily have been balanced between the two sides. Or the 2 outside wires might have been run to the center of distribution of a group of factories, and a local neutral

wire with balancing set used to carry the uneven distribution of load on the 2 sides.

This balance is necessary where there is much difference of horsepower, as otherwise the 2 sides of the system will not be carrying the same amount of load, and the unbalancing will lower the efficiency of the system.

For instance, suppose that on one side of the system between the outside wire and the neutral a 50-hp. motor was connected, and down the block 2 25-hp. motors were connected between the neutral and the other outside wire. If 1 of the 25-hp. motors were shut down, it would leave the system out of balance

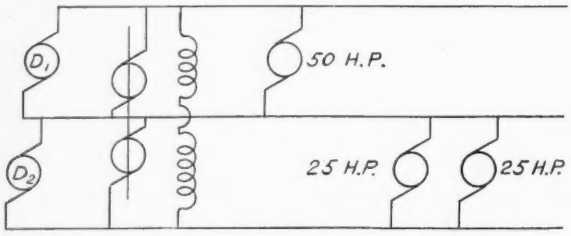


FIG. 3. THREE-WIRE DISTRIBUTION WITH BALANCER AT STATION

by the current which this motor was taking, and the rotary balancing unit would come in to carry this unbalanced current.

The 3-wire system for power gets much more complicated than for lighting, but where regular sized units are used it will cause but little trouble, and the mains to carry the same power require much less copper than the 2-wire system. The 3-wire distribution when properly installed and operated is a very pretty system.

ECONOMY IN ELECTRIC MOTORS

That a considerable saving may be effected in the energy used by electric motors is proved in tests made by the Hess-Bright Mfg. Co. on a motor equipped

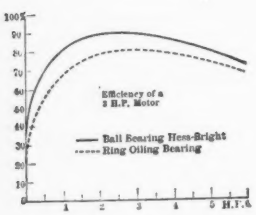


FIG. 1. VARIATION OF EFFICIENCY WITH HORSEPOWER FOR A 3-HP. MOTOR WITH STRAIGHT AND WITH BALL BEARINGS

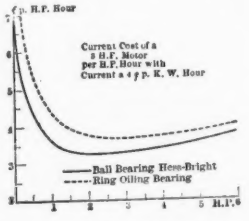


FIG. 2. COMPARISON OF CURRENT COST FOR A MOTOR WITH STRAIGHT AND WITH BALL BEARINGS

first with ring oiling bronze bearing and second with ball bearings.

Figure 1 shows the curves of relative efficiency on a 3-hp. motor. With a current cost of 4 cents a kw-hr., which is lower than the average cost for motors of this size the charge for current in the 2 cases is as shown in Fig. 2. For 10 hours a day and 360 days a year, the annual saving would be $30.

OPERATION OF COMPOUND WOUND GENERATORS

By Jacob Glogau

IN THE case of a shunt wound dynamo, the variation of the power delivered to the external circuit will cause the electromotive force at the terminals to vary, unless the current in the shunt field is altered in accordance with the variation in power delivered. It is quite impracticable to do this when the power is rapidly fluctuating through wide limits, first because it would necessitate constant attendance at the regulating devices and second, the variations would not be compensated quickly enough to keep a constant electromotive force.

This necessary regulation can be accomplished automatically and without the employment of mechanical devices, by dividing the windings of the field into 2 circuits,—shunt and series windings. The shunt windings give the correct no-load electromotive force while the series winding with either the whole or part of the current traversing it, varies the flux through the armature, thus compensating for the loss of electromotive force due to armature reaction and drop, and drop in the series field. If the number of turns in the series field be made large enough, the increased flux can be made more than sufficient to compensate for the loss of electromotive force, and the external electromotive force will rise with increase of current in the external circuit.

In lighting systems and isolated plants the overcompounding is 2 to 3 per cent; in railway work about 10 per cent. The electromotive force is 500 volts at no load and 550 volts at full load. The regulation is automatic and almost instantaneous, the amount being regulated by placing an iron or german silver shunt across the ends of the series coil which prevents the electromotive force from rising to too high a value, as it would with the total current traversing the field. By removing the shunt the full effect of the series compounding can be made available.

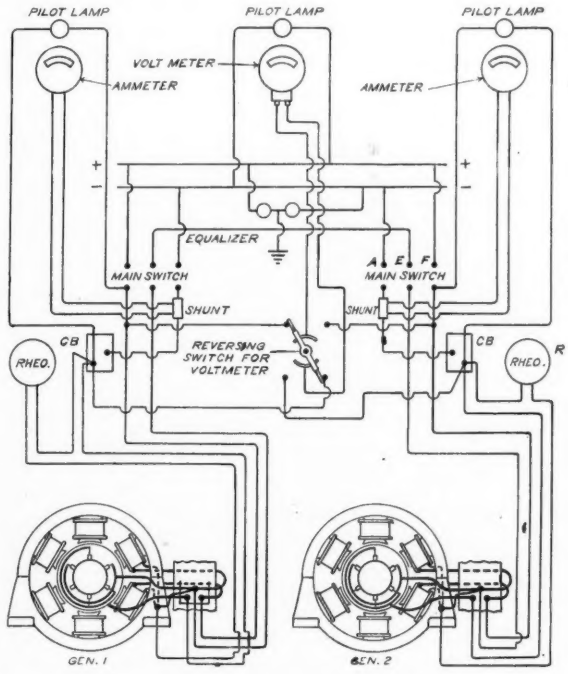
Paralleling

Figure 1 shows the connections of 2 compound-wound generators in parallel. To connect 2 compound-wound generators to operate in parallel, it is first necessary to see that the equalizer connection is right then look at the series main, armature main and lastly at the switchboard to see that all the connections are right; this is for the operation of machines in parallel that are just installed.

Suppose that 1 machine is in service, then to connect the second machine in parallel, first, close the equalizer switch E and also the series main switch; after this start to build up the voltage with the aid

of the rheostat, R. When paralleling, it is best to have the voltage of the incoming machine a trifle higher than the line voltage.

After this is done, the armature main switch A is thrown in, this operation putting the second machine on the line and allowing it to take its share of the load, which can be regulated by means of the rheostat after the machine is in on the line. We can tell whether the machines are taking equal loads by means of the reading of the ammeters.



CONNECTION DIAGRAM FOR TWO COMPOUND WOUND GENERATORS IN PARALLEL AND TO SWITCHBOARD

In taking the machines out of parallel, the same instructions are followed but in a reverse order; the rheostat is turned so as to decrease the field excitation, thus lowering the voltage of the outgoing machine until the load is off the machine; then the armature main switch is pulled; next the rheostat is turned in and the series main switch, and then the equalizer switch should be pulled out.

If the compound machines are of the same capacity, little trouble is found in operating them, but when 2 machines with different capacities are paralleled the resistance of the series windings and leads should be inversely proportional to the current capacity of the machines, that is, if one machine produces twice as much current as the other machine, its series field coil and lead that connects it to the equalizer bar should have 0.5 the resistance of that of the other machine.

The equalizer cable must be able to carry at least 0.5 the full current of 1 of 2 machines and more if more machines are used. Care must be taken in the operation of compound wound generators in parallel for, if the machines are subjected to a considerable overload or short circuited, the electromotive force and the current will rise and great strains will be produced in the machine and driving mechanism. In the case of a belted dynamo, the belt would fly off, causing damage and especially severe sparking at the brushes. This action is quite in contrast to the action of a shunt wound machine, whose potential would decrease with increase of load.

Connections of Compound Wound Generators to Switchboard

1. The ammeter and curcuit breaker should always be connected in the armature main.

2. It is best to connect the series main to the ground feeder or to the line feeder. When the series main is connected to the ground, there is a saving in cable, if connections be made direct to the ground feeder instead of going to the switchboard. In this case the circuit breaker would be connected in series with the armature between the armature and equalizer terminal. This circuit breaker and equalizer could then be mounted on the same panel near the generator and then no circuit breaker would be needed on the switchboard.

3. It is desirable in railway work to have the series main connected to the feeders where lightning is liable to do damage; in case the lightning arrester does not work, the lightning would not damage the armature as it would not reach it, because of the self-induction of the intervening series coil, which is the reason why electrical manufacturers recommend that the machines be connected up in this way.

WATER POWER VS. STEAM POWER

The effect of variable flow upon the value of a water power is difficult to estimate. "I am firmly convinced," says Chas. T. Main, of Boston, "that today many concerns are located upon streams which are so variable as to require an auxiliary steam plant of a size equal to the water-power plant, or nearly so, to which in the past such water power may have been a saving, but which now, if they could begin anew, could produce their power more cheaply from a steam plant alone than from the double plant.

"It is true that fuel is saved, if steam is not required for other purposes than power, during such times as the engine is not run; but it is also true that as the engine is only to run for a portion of the time, it is probably deemed advisable to purchase a low cost steam plant in order to reduce the fixed expenses, which means a larger consumption per hour than there would be with a better plant. At times also the engine will be without load, which is not conducive to economy. To the running expense must be added the cost of maintenance of a double plant, so that the cost is almost sure to be more than that of a single new efficient plant."

WITH THE EXAMINING BOARD

By James Browning

1. What is a throttling engine?

A.—In a throttling engine, the governor controls the speed by throttling off or increasing the steam supply. This governor consists of a disk valve mounted on a spindle which extends upward through a suitable stuffing box. A frame supports the governor proper, which has 2 or 3 balls whose outward motion, due to centrifugal force, is resisted by the tension of springs. When the centrifugal force overcomes the tension of the springs, the valve stem is forced downward, closing the valve and reducing the pressure of the steam which enters the cylinder, hence the speed. When the tension of the springs overcomes the centrifugal force, as when the speed drops, the valve is raised and the pressure of the entering steam increased. In this type of engine, the lead, lap and valve travel remain the same regardless of the load which the engine is carrying.

2. What is an automatic cutoff engine?

A.—In the automatic cutoff, the regulation of speed is secured by varying the volume of steam admitted to the cylinder each stroke, maintaining the steam pressure at that in the steam chest. The steam is not wiredrawn to so great an extent as in the throttling type, so that the engine has a better economy.

In the high-speed, automatic engine the eccentric is supported upon a movable disk, the position of which is controlled by the governor mechanism attached to the flywheel. When the speed increases above that for which the engine is set, the governor weights fly out and increase the angle of advance of the eccentric. The result of increasing the angle of advance is to make the cutoff earlier and increase the amount of compression, then the work done by the steam is less. Or when the speed decreases the weights move inward, which decreases the angle of advance, consequently the cutoff takes place later, and the work of the steam is increased. In this manner the speed of the engine is kept normal.

3. What is meant by lead?

A.—Lead is the opening given to the port when the crank is on the dead center.

Lead is given an engine to help cushion the piston at the end of the stroke, and to fill the clearance space. There are 2 classes of lead, positive and negative. Positive lead is meant when lead alone is used. Negative lead is the reverse of positive, and means that when the crank is on the dead center, the steam edge of the valve will project over, or cover, the steam edge of the port. In other words, the piston would have to move some distance before the port would be opened.

4. What is meant by lap?

A.—Lap is that part of the valve which extends beyond the steam port width, when the valve is in the center of its travel.

There are also 2 kinds of lap. Steam lap, or outside lap, as it is generally called, and inside or exhaust lap. Outside or steam lap is the amount the steam edge of the valve projects beyond the steam edge of the steam port, when the valve is in its mid position. Increasing the outside lap gives an earlier cutoff, increasing the expansion. Decreasing the outside lap means a later cutoff with a diminished expansion.

Inside or exhaust lap is the distance the exhaust edge of the valve projects beyond the edge of the port, when the valve is central. Increasing the inside lap causes the compression to begin earlier in the stroke, and causes the release to take place later. Decreasing the inside lap causes the compression to begin later and hastens the release, or exhaust. Many engineers think that they can change the lap by shortening or lengthening the eccentric rod; or by moving the eccentric. This is not correct, as by shortening the rods or moving the eccentric, we pull the valve away from its central position. To reduce the lap of a common slide valve, we must reduce the width of the valve. To increase the lap, we must add a piece to the edge of the valve.

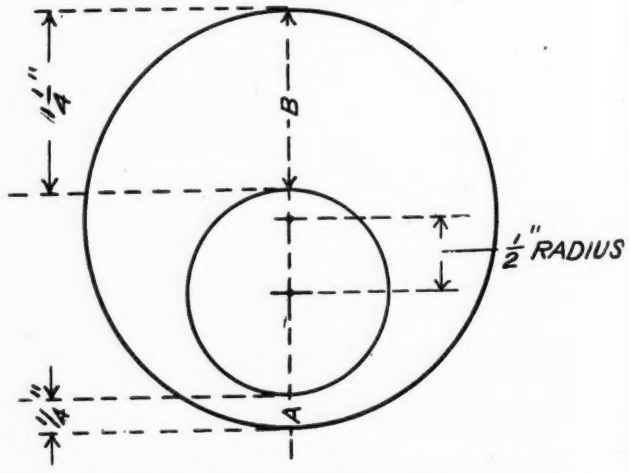


FIG. I. CENTER OF ECCENTRIC FALLING INSIDE THE SHAFT

5. What is the travel of a slide valve?

A.—The travel of a slide valve is the total distance the valve moves in one direction, and is twice the radius of the eccentric; this, of course, if there are no rocker arms in the valve motion to change the throw.

6. What is the radius of an eccentric?

A.—The radius of an eccentric is the distance between the center of the eccentric and the center of the shaft.

The radius of an eccentric is sometimes called the throw, but this is incorrect, as the throw is twice the radius. It is sometimes difficult to measure the radius of an eccentric when the eccentric is on the shaft, on account of the center of eccentric and the center of the shaft coming inside the shaft circumference, as shown in Fig. 1. A correct method of finding the radius is to measure from the shaft to the large part of the eccentric marked B, then measure from the shaft

to the small part of the eccentric marked A. Subtracting A from B will give the throw.

Figure 2 shows an eccentric with the same radius and same throw as Fig. 1, but the circumference is larger. Therefore, it goes to show that when the eccentric becomes worn out of round it may be turned up in the lathe without affecting the throw.

7. How do you find the dead center of an engine?

A.—Place the crank a little above the center tram

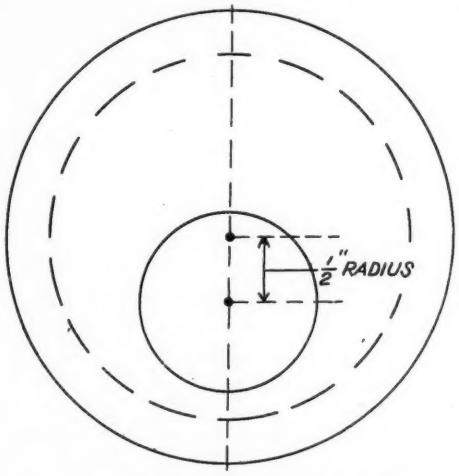


FIG. 2. EFFECT OF TURNING OFF ECCENTRIC

from the floor to the flywheel rim, making a mark on the guide and the crosshead. Then put the engine below the center until the marks at the crosshead line up again, and tram from the floor to the flywheel.

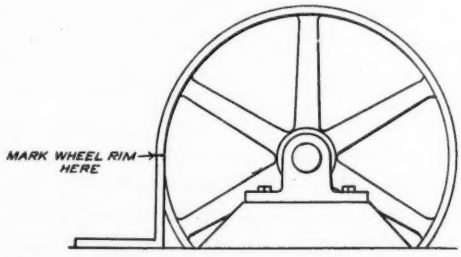


FIG. 3. FINDING AN ENGINE'S DEAD CENTER

Divide the distance between the marks on the flywheel; then tram from the floor to this center mark.

In finding the dead center of an engine, the engine must be turned in 1 direction, as by turning it in 1 direction at all times, the lost motion will be taken up. After an engine is placed on the dead center, a square should be placed on the floor, as shown in Fig. 3. Then a mark made on the rim of the wheel. The dead center is found after this without the use of a tram.

8. Are there any advantages in the Corliss, over the single valve types of engine?

A.—Yes; you can change the lap on the Corliss valve gear, or change the compression in some cases while the engine is running. The valve having only 1 steam edge, as there are 4 distinct valves, any desired lap may be given by adjustment of the radial rods from the wristplate to each valve. The exhaust valves, being below the cylinder bore, no cylinder cocks are needed.

Another advantage is the exhaust steam and condensation does not pass out through the same ports by which the live steam enters, therefore, the ports are not cooled so much at each revolution, as is the case with the common slide valve. The steam ports are short, making the clearance small, therefore the Corliss engine is considered more economical than other types.

JOHN F. STEVENS, formerly chief engineer of the Panama Canal, gives a summary of his conclusions as to the usefulness of that enterprise in the Business World that is interesting, even if not in line with the ordinary views of the case. He calls attention to what trade of the United States can possibly go through the canal after it is finished, stating that practically all the population of South America is east of the Andes, and that their trade comes to the Atlantic ocean through the great navigable rivers. So far as Africa is concerned, the distance through the Panama Canal is greater than eastward through the Suez Canal. As to the Asiatic countries, he calls attention to the fact that we need all our coal, wheat and lumber, or shall do so in a few years, for our own uses, that China has better iron and coal supplies than we have, and cheap labor to put them on the market. He grants some possible trade in cotton and cotton products and that the Philippines may send us lumber, jute, sugar and coffee.

He estimates that in order to pay interest on the first cost of construction, create a fund for maintenance and operation, and a sinking fund for retirement of the bonds, a yearly income of $18,400,000 must be raised. He points out that the Suez Canal, after 36 years, has now a yearly traffic of 11,160,000 tons, which at $1.50 a ton would give a gross yearly revenue for the Panama Canal of $16,740,000, less than enough to meet the fixed and operating charges. His conclusion is that the Panama Canal must handle from the very start a yearly tonnage larger than the Suez Canal now does after 36 years of existence if it is to be self-sustaining. He further points out the fact that at the present time the trade with South America is almost entirely in the hands of European countries and that, if we are to take any of this trade away from them, we must learn to encourage our merchant marine, to adapt ourselves to the wants of the people with whom we are to trade, and to get over our conceit in our own ability, a conceit which is not shared by the rest of the world.

IN A CASE OF LOW WATER, immediately bank or cover the fire with ash, or if no ash is at hand, use fresh coal, and check the draft. Don't turn on the feed nor tamper with or open the safety valve.

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CONTENTS

The Power Plant of a Lead Works. Illustrated..... 19
Heating a Building by Steam. Illustrated..... 25
Connecting Water Columns. By P. E. Merriam. Illustrated 28
Do Gas Engines Need Engineers? By W. L. Weber..... 30
Gas Engine and Producer Guarantees. By C. E. Lucke..... 32
Gas From a Worthless Coal..... 34
A New Plant for Pump Building..... 35
Voltage Drop in Direct Current Lines. Illustrated. By R. W. Stovel and N. A. Carle..... 36
Bad Electric Distribution. Illustrated. By C. R. McGahey. 37
Economy in Electric Motors. Illustrated..... 38
Operation of Compound Wound Generators. Illustrated. By Jacob Glogau 38
Water Power vs. Steam Power..... 39
With the Examining Board. Illustrated. By James Browning 40
Editorials. Learning Economy. Care in Little Things. Circular Mils. Scale in the Furnace. Gas Engine Horsepower 42
Preliminaries to Shutting Down an Ice Machine. Illustrated. By W. S. Luckenbach 44
Compression Ice Plants Using Ammonia. By Thomas Shipley 46
Kinks from the Road. Illustrated 49
Letters from Engineers. Illustrated. Why Does Engine Pound? The Safety Valve. Safety Valve Area. Evolving a Die Stock. Getting Engineering Knowledge. Dash Pot Repair. Trap in Vacuum Heating System. Oil Pumping. Setting Valves of Duplex Pumps. Heating Water by Steam. Leaky Manhole Gaskets. Home Made Oil Can.. 50
A Steam Turbine Driven Paper Mill. Illustrated..... 56
Hydraulic Ram. Illustrated 57
Novel Reducing Motion. Illustrated..... 59
Feed Water Filtration. Illustrated..... 60
The Angell Steam Trap. Illustrated..... 61
Questions and Answers. Illustrated..... 62
Bracing Boilers. Illustrated..... 64
Economizer Improvements. Illustrated..... 67
What the Name Albany Means..... 68
Receiver Pressure Regulator. Illustrated..... 68
Berry Feed-Water Regulator. Illustrated..... 69
A New Pipe Wrench. Illustrated..... 71
The Linton Combination. Illustrated..... 71
Winters' Vacuum Trap. Illustrated..... 72
Graphlio, a New Lubricant..... 73
Mechanical Stoking for Bituminous Coal. Illustrated..... 73
A Twentieth Century Product..... 74
News Notes 74
A Practical Metallic Packing. Illustrated..... 76
Canadian Engineers' Convention..... 76
Books and Booklets 76
Trade Notes 77

LEARNING ECONOMY

Whether because we are growing up as a nation or because prices are getting higher, or because we want more luxuries and are, therefore, not willing to spend so much on necessities, the movement for preserving and economizing in the use of our national resources is fortunately gathering headway.

On all sides we see the agencies at work toward this end. Not only has President Roosevelt called attention to the matter through the congress of governors of states, but the Fuel Testing Commission of the Geological Survey and the experiment station of the University of Illinois have been working for several years on the problems of getting the most out of coal and of using coal which has been considered of no value.

One of the most interesting of the reports from the fuel testing board will shortly appear, telling how a gas engine was driven by means of a producer on coal that had been considered unmarketable. The summary of the tests is given in this issue and a complete report is to be expected before long. We are witnessing the exploitation of new fuel fields in all directions. The latest comes from Alaska, where a mountain of coal has been discovered toward which the railroads are racing for possession.

We are learning, too, to use the power which has heretofore been wasted. Not only in the thickly settled parts of the country, but in the wilderness, where only the hawk and the wolf are to be found, we now build great power houses from which wires carry the energy to our manufacturing centers. In Mexico, the entire capital city gets its light, its power and its street car current from a waterfall 95 miles away.

Throughout the Rocky Mountain region great dams are being constructed by the United States Reclamation Service which have 2 objects. The main reason for building them is to create great reservoirs from which water may be led by canals to irrigate land which has heretofore been desert. Hundreds of thousands of acres will, within the next year, be made available. With the water once supplied, these desert lands, which constitute two-fifths of the area of the country, will become the most valuable farming land that we have.

Of course, the water for this irrigation must be stored back in the mountains, and in its descent to the valleys where it is to be used for irrigation it will be forced to drive great generating units which will furnish power and light to the farmers.

In distinction to this undertaking is the draining of swamp lands in Wisconsin, Florida and the Carolinas, where too much water, instead of too little, has been the difficulty. By means of great canals and, where necessary, pumping stations, these swamp bottoms are being under-drained and made available for cultivation; bottoms where the rich black soil is 10 ft. deep and the fertility inexhaustible.

Besides this work of reclaiming waste land there has been going forward in the experiment stations of the western states a systematic search for seed which will produce greater crops on land already under cultivation, either in very dry regions or in very cold regions. By careful selection and cross fertilizing, and by getting seeds from the plains of Siberia and the arid plateaus of Asia, it has been possible to produce twice, and even thrice, the harvest that was formerly secured from the dry farms in Arizona, New Mexico and Colorado, and from the bleak prairies of North Dakota and Montana.

The latest development in this line comes from Idaho, where a farmer, Abraham Adams, by name, has announced the production of a new kind of wheat which will increase the yield ten-fold over the ordinary crop; and in the line of increasing food products comes also a unique suggestion from a Pacific Coast scientist that we are allowing to go to waste in the form of sea weed, which, if properly prepared, is nutritious and palatable, enough of a crop to support the entire population of the world, if all other sources failed.

Besides conserving the fuel stores, developing our water powers and utilizing our food supply, we are turning to the other possible sources of energy. Along the coast of Maine a serious attempt is being made to utilize the power of the tides, and with every prospect of ultimate success. The tremendous energy in the waves has excited the covetousness of power engineers in all time, and while this problem has not yet neared solution it is not impossible. Subduing the tempest and making it do useful work has been partly accomplished, and will, undoubtedly, be carried further as the price of fuel increases, and the problem of getting day labor out of the sun's rays seems to have found solution in the system of power farming devised by Mr. Shumway.

All these things point us to the fact that we as a nation are beginning to learn economy of our natural resources, and it is high time. Our forests have been wantonly wasted until not only is the lumber supply of the country in near danger of disappearing, but the floods are washing our fertile hillsides into the river beds. Our best stores of coal have been skinned, considerable part of their contents being needlessly lost. We are in the position of a young man inheriting a large patrimony, and having spent a good portion of his fortune, waking up to that fact and trying to save the rest.

Happily, we seem to be coming quickly to a realization of what has happened and with characteristic American determination, starting to set our house in order. It will be well if, as individuals, as well as in our national policy, we come to a realizing sense of our duty to use wisely the good which God has given us rather than to squander it as if the supply were inexhaustible and could be replenished by some magic power.

CARE IN LITTLE THINGS

It is not often that difficulties arise in the average power plant with regard to the big things of the plant. A well-built engine may run for years without the need of special attention other than adjustment of bearings and attention to packings, and these would be classed among the little things. Also, in putting up a plant, the kind of engine to give the best economy, the kind of boiler to get the most out of the fuel, and the arrangement of the main piping to give the best results usually have careful attention, but the arrangement of drip piping, the connection of traps, the use of the best kind of valves at all points, especially in the smaller sizes, is left to the steam fitter and to chance. Yet in the daily running of the plant and the convenience of keeping it keyed up to the best working condition, the arrangement of the smaller parts and of the small piping is of fully as much importance as that of the big things.

In this issue Mr. Merriam calls attention to some points in the connecting of water columns. Generally a water column is stuck on almost anywhere, according to the notion of the boiler maker, so long as it indicates with reasonable accuracy the safe water level. Study of this article will show that there are considerations that ought to be taken into account even in so simple a matter as this.

In the putting up of very large plants, the smaller piping is apt to receive better attention than in the small plant, for the expense of the small piping in a big plant is so considerable that it pays to be careful. In a small plant a few rough sketches are often made for the big piping and the small piping is stuck in afterwards, anyhow and anywhere. In the plant of the Raymond Lead Co., which is described in the leading article, particular care has been paid to this matter because Mr. Guertler, who designed the plant, has been accustomed to the handling of larger propositions and brought to this plant his experience in that field. The piping of the boiler feed pumps, which is shown in detail, is an illustration. These are connected so that suction may be taken either from the city mains or from the feed heater, and the discharge may be to the house system, to the boilers or to the fire mains. By a simple system of cross connection and valves it is possible for either pump to be drawing from the city service while the other one is taking from the heater and either of these pumps may be discharged into the boiler while the other one is discharging to the fire system of the house service. Furthermore, in this plant the high-pressure outside packed plunger pump with pop valves has been used; the extra first cost is not great and this gives a pump which is easily taken care of, is very durable and serves in emergency for fire pump as well as boiler feed.

The difference between a successful and convenient plant and one which is wasteful and irritating is usually the difference between the brains spent in arranging and installing the minor machinery.

PRELIMINARIES TO SHUTTING DOWN AN ICE MACHINE

By W. S. Luckenbach

AS THE season for repairs and improvements in an ice making or refrigerating plant is again near at hand, it behooves the man in charge to investigate the entire plant, including the various adjuncts he may have, such as steam flue cleaners operated from the combustion chamber, heater and purifier, high and low-water alarm, mercury wells, and automatic ammonia regulator where the absorption system is installed.

If he has any or all of these mentioned, and has kept a complete record when making his daily routine

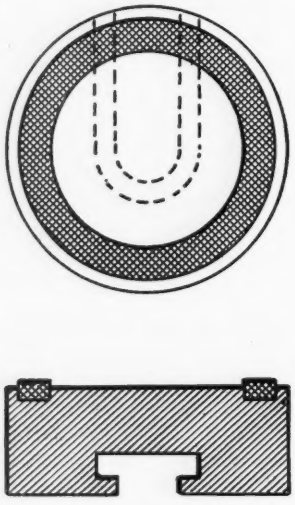


FIG. I. A TIGHT SEATING DISK FOR BLOWOFF VALVE

of inspection, he is in good shape to formulate plans for additional improvements. If he has not kept a record he should start one at once in order to determine the advisability of incurring the additional expense of installing such apparatus as experience elsewhere has demonstrated will not only increase the output but lessen labor, both in the fire and engine rooms. The above remarks, and some of the following apply to both systems, but this article is principally written in regard to the absorption system.

Steam Boilers

These need a thorough overhauling from grate bars to safety valve; they should be examined and repaired by thoroughly competent men. Both the regular and surface blowoff must be cleaned or replaced by new ones. The location of the surface blow should be so arranged that the top of the pipe be about half way between the second and bottom gage cock, and in blowing off use the bottom blow first because this brings the water level nearer to the openings of the surface blow, thus greatly assisting in the purification of the water when the top blowoff is opened; the surface blow pipe should extend nearly the entire length of the boiler and the openings be on top.

The blowing off, however, should be done only when actually necessary, because any more causes a loss of fuel. It should be regulated by the purity of the feed water, and right here is where a first-class heater and purifier is almost indispensable, because it furnishes feed water at not less than 205 deg. and deposits about 80 per cent of the impurities on the plates; hence, there will be less boiling water to be wasted by blowing off, and a corresponding saving of fuel.

It frequently happens that some sediment lodges on the blowoff valve seat, causing a leak which cannot well be detected unless the end of the blowoff pipe is exposed; it also damages the valve seat and disk, and is, of course, a constant drain on the coal pile. The writer has used a valve similar to the illustration, Fig. 1, for a number of years with entire satisfaction. The valve seat is cast iron; the valve disk is grooved, filled with good babbitt metal and faced true. When any sediment is arrested on the seat when closing, it will imbed itself in the babbitt metal and invariably make a tight joint; the disk needs renewing 2 or 3 times during the season, which can easily be done by slipping it off the stem, cutting out the old metal, refilling and refacing, the whole job being done in less than 2 hours.

Steam Flue Cleaners

The steam flue cleaner mentioned has a number of good points; first, it saves labor, second it is conducive to cleanliness, because the soot is blown in line with the draft and out the stack, instead of blowing it into the combustion chamber, thus causing more or less soot in the boiler and pump room, and above all it saves fuel by reason of the flue doors at the uptake being closed at all times and the regular steam pressure maintained without extra firing.

High and Low Water Alarm

The high and low-water alarm should be attached to every ice making plant, especially when an absorption system is installed, because impurities pass over with the steam in case the water gets too high, and when in the course of time the impurities show in the ice the engineer is at a loss to know positively the cause, hence the high water whistle say, 48 hours before, would enabel him to locate the cause at once and give him no further concern.

Water Pumps

The water pumps, both the boiler feeders and large circulating pumps, must be carefully examined while in operation and their needs noted; have the suction from the heater and the discharge pipe covered; with a thermometer inserted between the pump and the

boiler, it will surprise you to note the difference in the temperature of the feed water compared with uncovered pipes. If pumping from well or river, do not forget the suction check, as a defective check during the season is a serious draw back.

If possible, use either belt or motor drive instead of steam; this applies equally to the ammonia and air pump, because the boiler pressure can then be reduced, which means less heat units to be extracted from the liberated gas in the condensing coils, and the distilled

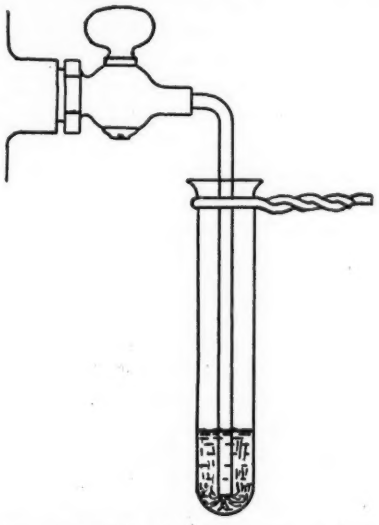


FIG. 2. TESTING AMMONIA FOR MOISTURE

water tank and cooler, which in turn means less cooling water to be pumped for that purpose, and less power required.

Generator and Rectifier

The generator and rectifier must be thoroughly investigated before shutting down, as the life of the machine principally depends upon the quantity and quality of gas generated. If, however, the gas is pure and the capacity of the machine easily maintained during the hot weather, the question of dismantling the generator and rectifier must be left to the judgment of the man in charge, and while it is quite a task to dismantle, yet it is not advisable to take any chances with a possible loss of 10 or 15 per cent during the busy season.

In determining the quantity of aqua ammonia at 26 deg. Beaume required per ton of ice, 7 cu. ft. per hour for 1 ton of ice in 24 hours is approximately correct and can be readily figured out by taking the cubic contents of the cylinder, multiplying by the number of strokes and allowing, say 5 per cent for slipping due to imperfection of valves or plunger.

The quality of gas generated can be easily determined by the following method:

There is usually a purge cock near the expansion valve, between it and the condensing coils. Thread 1 end of a piece of pipe the same size as the outlet of the purge cock, screw it in the cock and bend the pipe, if necessary, so that it will stand vertical. Take a glass test tube or piece of 1-in. pipe 12 in. long, capped on 1 end, and attach a stiff wire or rod about a foot long so as to keep the tube that distance from the hand. Now open the cock a trifle to allow some to waste, then slip the tube over the pipe until near the bottom, and open the cock easily. As the liquid ammonia flows into the tube, withdraw it gradually until there is a certain number of inches in the tube; pour it into a vessel and let it evaporate by setting it on ice or in cold water, and the residue is the percentage of moisture, which should never exceed 3 per cent. Repeat the operation to verify the result. Should there, however, be excessive moisture, then the rectifying pans are at fault and the rectifier must be dismantled.

Absorber

Next in importance in the production of cold is the absorber, and presuming it to be of standard size and properly erected, it only remains to ascertain whether the cooling coils or pipes are in condition to warrant running another season. In order to determine this definitely, we will assume that it has circular coils, connected top and bottom to manifolds, each coil having inlet and outlet valves for both steam and water. First thoroughly clean the coils internally, which is done while the machine is in operation, by taking 1 coil at a time and turning the full steam pressure on for a few minutes to cut the accumulated dirt and slime; then shut off and turn on full water pressure to wash out; continue until all are clean.

This may take several days because the use of steam will naturally increase the temperature and pressure, hence it will be necessary to discontinue until both temperature and pressure are again normal. After they have been cleaned, test them with cold water one at a time to 300 lb. Now pump the water through the coils in the regular way, and after running about 5 hours test the water for ammonia; if none is present, the coils are in good condition for another season. Should there be traces of ammonia in the waste water, turn off 1 coil at a time, and after about half an hour, make a test; if traces are found, you have the right coil, and cut it out, but verify it before doing so. Continue until the bad coil is found. This method, with some variation, applies to all makes of absorbers, and also to the cooling coils in the distilled water tank.

The expansion coils in the freezing tank, and gas coils in the cooler tank also need careful attention, but as this can only be done after the machines are shut down, it now only remains to detail the method of shutting down and planning every detail before commencing, so that the work will be thoroughly and expeditiously done.

SAFETY VALVES should be inspected daily as they are liable to become fast in their seats and useless for the purpose intended.

COMPRESSION ICE PLANTS USING AMMONIA*

By Thomas Shipley

THE apparatus which goes to make up an ice plant can be divided into 3 heads: 1. Those parts which have most to do with the quantity of ice to be produced. 2. Those parts which have most to do with the quality of ice to be produced. 3. Those parts which have most to do with the economy or cost at which the ice is to be produced.

Under the first head comes the ammonia system, which is the cold producer, and has most to do with the capacity of the plant, and the first thing to be considered is the temperature to be produced. This governs the ammonia evaporating apparatus. Then comes the means to be employed to relieve the ammonia evaporating apparatus of the gas formed in it. This governs the size of the ammonia compressor to be used. Then comes the liquefaction of the ammonia gas so it can be used over again. This governs the ammonia condensing apparatus.

Evaporating Apparatus

The ammonia evaporating apparatus must give the required temperature at the highest possible pressure, for upon this pressure depends the size of the compressor to be used. Then the pressure here must be as near uniform as possible, for this governs the temperature within the apparatus, and consequently its efficiency.

The pressure at the end where the liquid ammonia enters, which is commonly called the expansion end, is necessarily higher than at the gas end, so as to get a circulation, but the difference should be kept as low as possible, as the temperature varies with the pressure.

It would surprise many of you if you knew how much of a difference in pressure there is in your freezing coils. If you investigate, you may find that the temperature at the expansion end is higher than the temperature of the brine, because your coils are so arranged that the gas, when formed, can not get away. They are too long, or are choked. They ought to be free and allow the gas to get out as quickly as possible. Another thing, the internal surface of the coils should be kept wet with liquid to make them effective. The pipes which are filled with gas do very little of the ice making work. It is those which are wet with liquid which are most effective.

Most of you have from 300 to 350 ft. of 1¼-in. pipe, or its equivalent, per ton in your freezing tanks. You can get along with from 2/3 to ½ this amount if it is properly arranged.

On an experimental plant which we operated at our works, we made 4 tons of ice a day with a double pipe evaporating system, consisting of 4 2-in. pipes inside of 4 3-in. pipes, each pipe being about 16.5 ft. long. The brine passed through the 2-in. pipe and around the outside of the 3-in. pipe. This gave about 24 sq. ft. of pipe surface per ton as against 130 to 150 sq. ft. used in the average freezing tank.

Our recent experiments at York corroborated the above experiment, and upon experimenting with the usual style of freezing coil, we found that every square foot of evaporating surface of a flooded system produced at least twice as much cold as that which could be produced by the same surface in an expansion system, both being operated under exactly the same evaporating pressure.

In a flooded system the liquid ammonia is fed into a trap, from which it enters the bottom of the coil, passing upward and through same, and is discharged back into the same trap it started from, where the gas that has been formed is separated from the liquid which remains, the gas going through the top of the trap to the compressor, while the liquid is thrown down in the trap, where it mingles with the fresh liquid being fed into the trap and the cycle is repeated. The ammonia pressure in this system is as near uniform as is possible. This cycle is the same as that which takes place in water tube boilers.

In an expansion system the gas from cooling the liquid ammonia, must pass through the entire freezing system, doing no work and preventing the surface it is in contact with from doing useful work. In this way the efficiency of the system is materially decreased. In the flooded system this work is done within the trap, the gas going directly to the compressor, while the cooled liquid enters the evaporating system to do useful work.

Agitating the brine in a can freezing tank adds materially to the efficiency of the evaporating coils. There is no limit to the speed at which the brine should be circulated as long as it does not slop over into the cans or out of the tank.

The suction connection between the evaporating apparatus and the compressor should be large and without restrictions that will reduce the pressure of the gas entering the compressor. This is one of the old time mistakes, and should be avoided. The pressure at the compressor governs the size of the compressor, while the average pressure in the evaporating apparatus determines the temperature and value of the surface in that apparatus.

It would be well for you to determine, for your own satisfaction, just what pressure your plant is really working under. It will explain some of the things which sometimes puzzle you. All piping or apparatus containing ammonia, from the liquid valve to the compressor, should either be doing work or

*Abstracted from a paper before the National Ice Carnival.

be insulated. The losses sustained from not following this rule are very considerable.

The Ammonia Compressor

The compressor will have to handle, under the average conditions, about 40 lb. of ammonia gas per ton of ice, and the size of the compressor depends on the volume of this gas and the efficiency of the compressor. The volume of the gas depends upon the pressure at which it enters the compressor.

Some compressors will not give more than 50 per cent efficiency, owing to the clearance, and to the bad design of valves and connections, while in others the efficiency will be 80 per cent. This efficiency question is one which everyone buying or operating ice making machinery should understand.

You should remember that the efficiency of a compressor varies with its back pressure, this back pressure being the pressure at which the gas will be delivered to the compressor. A 14-in. compressor at 80 per cent efficiency will do the same work as a 17-in. compressor at 50 per cent efficiency, both at the same stroke and running the same revolutions.

The efficiency of a compressor should be kept as high as possible, for if it is not kept up, not only will the capacity decrease, but in addition the horsepower per ton will increase. Some operating engineers do not believe it is policy to shut down a machine to adjust the valves, etc., fearing to lose capacity. Very little trouble in the compressor will cause the efficiency to drop 10 per cent.

If the working efficiency of your machine, when in good condition, is 80 per cent. you lose 3 hours a day by allowing the efficiency to drop to 70 per cent, and you would make up a 12-hr. shut-down in 4 days, provided that the efficiency was brought back to 80 per cent.

It pays to look over the machine once in a while. The best way to keep in touch with the condition of the compressor is to have mercury wells in the suction and discharge connections and keep a record of the temperature of the ammonia going in and coming out of the compressor.

If liquid is allowed to enter the compressor with the suction gas, a reduction in efficiency will be the result. The ammonia gas should enter the compressor slightly superheated, 5 degrees being about right. To run the compressor wet compression is bad practise.

Our experiments at York have proved that a compressor can do as much work, running 44 revolutions under dry compression conditions as it will running 61.5 revolutions under wet compression conditions. This was with a back pressure of 15.67 lb. above atmosphere, which is the pressure mostly used in making ice, and gives an evaporating temperature of 0. If the back pressure is lower, the difference will be greater. If it is higher, the difference will be less.

The Condenser

From the compressor we go to the ammonia condenser. The size of this apparatus depends upon the condensing water available. The higher the temperature of the condensing water the more surface is required per ton of ice. The condenser should be so placed that a current of air will pass around it all the time.

A condenser is throwing off heat, and if it is in a confined space, it will soon heat up the surrounding atmosphere to such an extent that it will interfere with the good working of the apparatus. The surface and double-pipe condensers are the ones most generally used on modern plants. The double-pipe type are the most economical in water, as well as surface required, but must be looked after in freezing weather, or the water pipes in them will freeze up and burst.

After the ammonia is liquified in the condenser, care should be taken that it does not come in contact with heat greater than its own heat, and it should never be piped through the engine room or boiler room, unless it is insulated.

The ammonia receiver should be placed in a cool place, preferably alongside the freezing tanks, so as to reduce the temperature of the liquid as low as possible. It is also good practise to put in a liquid cooler to cool the liquid on its way between the receiver and the evaporating apparatus.

Every degree which can be taken out of the liquid ammonia by natural means reduces the amount of ammonia to be handled by the compressor to produce the capacity of ice. For instance, if your condensing pressure is 200 lb. the temperature of the liquid leaving the condenser will be 100 deg. If your back pressure is 15.67 lb. above atmosphere, the evaporating temperature will be 0.

The latent heat of vaporization of liquid ammonia at 1.567 lb. pressure is 555 B. t. u. Of this, 100 B. t. u. will be required to cool the liquid itself from the temperature at which it leaves the condenser to the temperature at which it is evaporating. This work of cooling the liquid equals about 18 per cent of the total work done by the compressor, or 1 stroke in every 5.5 is lost so far as ice production is concerned, and it is to reduce this loss that a liquid cooler is useful. This is the work referred to in the discussion of evaporating systems. The ammonia receiver should never be put in the engine room, unless it cannot be avoided. Then it should be well insulated.

Water Cooling

Another part of the equipment which affects the capacity of the plant is the apparatus used to cool the water to be frozen into ice. This water should be cooled down to a temperature as close as possible to that of the coldest cooling water available, for every 2.5 deg. that the water is cooled or heated means about 1 per cent of the total work which the cold producing part of the plant is required to do to produce the ice.

Purification

In plants where distilled water is used, the purification process should begin with the feed water before it goes into the boilers.

This water should be thoroughly filtered, and where it contains any quantity of foreign matter, it should be heated in an open heater, so arranged that a small quantity of the steam is allowed to escape all the time. This will carry away much of the objectionable gas.

The boilers should be kept as clean as possible. Where exhaust steam is used a mechanical oil separator is preferable to the old-fashioned coke tank.

The condenser should be well vented to allow the gases to escape and care should be taken that the distilled water leaves the condenser at as near to the boiling point as possible, for the hotter it leaves the condenser the less gas will be reabsorbed, and the hotter it goes to the reboiler, the less steam will be required to reboil it.

A long flat reboiler will more thoroughly reboil every part of the water than the old round tank reboiler, and it will allow the gas to escape without coming in contact with and being absorbed by the incoming water.

Some waters hardly need reboiling at all. This explains why some designs of apparatus produce good ice in one locality, whereas they will not in others. It is better to be prepared for the worst when the difference in cost is so slight.

Charcoal filters should be cleaned often, because they are continually becoming fouler, and after a while will add to the impurities contained in the water instead of removing them. The water cooler is a good purifier and should often be blown out and thoroughly cleaned with steam. Care should be taken to keep the distilled water apparatus full of water, so as to prevent air from being admitted to it, and in this way make white ice.

In plants where raw water is used the water should be well filtered and the tanks kept clean. In making ice from raw water it should be borne in mind that water in freezing throws out impurities, and the water remaining in the tank after the ice is frozen is heavily charged with these impurities and should be either run off or passed through filters.

If the water is cooled down to 40 deg. F., or below, before it enters the freezing tank and is then kept well agitated, little trouble will be experienced in making clear ice, whether from distilled or raw water.

Steam Equipment

Under those parts which have most to do with the economy or cost at which the ice is produced the steam generating apparatus is the chief factor and it should be first-class in every respect, or economical operation cannot be expected.

Labor-saving devices, such as coal handling, ice pulling, oiling systems, etc., are all parts of the plant which materially affect the cost of production and should have careful consideration.

On a can plant the steam consumption of the engine to drive the compressors and the auxiliaries should be kept within the amount needed to make distilled water. In this way the amount of steam used can be kept at the minimum by the engineer. The main engine should be a Corliss engine and the auxiliaries be driven from an electric unit.

On a plate plant, which is steam driven, the engines driving the compressors should be compound condensing, and all auxiliaries be driven from an electric unit.

There are many ways of changing the proportions of the different parts of a plant to suit one condition or another. By increasing the number of cans in a can plant, or by increasing the plate surface in a plate plant, a higher freezing temperature may be used. This may be taken advantage of by an increase of back or evaporating pressure and a smaller compressor capacity, or by a reduction in the evaporating surface or freezing coils.

Some compressors must have more cans or plate surface than others, because, while they (the compressors) may be the same size, their efficiency or capacity is not the same, and they must work at a higher back pressure to do the work. This means a higher brine temperature and more cans or plate surface.

If the distilling and purifying apparatus are not efficient, it is necessary to freeze the water at a high temperature, so that the ice may throw off some of the impurities contained in the water during the process of freezing. In this way the freezing apparatus must do the work which should have been done by the water purifying apparatus.

A well designed can plant, making distilled water ice, equipped with noncondensing engines, and using 60 deg. water, can produce 7.5 tons of ice per ton of coal. To do better than this the engines must be made compound condensing and an evaporating system put in. Taking a 100-ton plant as a basis, this additional apparatus will raise the total cost of the plant from 20 to 25 per cent. Ten tons of ice per ton of coal is about the best output such a plant can produce. Figuring coal at $3 a ton, this means a saving of 10 cents a ton of ice.

The extra labor, supplies and additional wear and tear reduces the saving effected to a point where it is a question if there is any saving at all to compensate the additional investment.

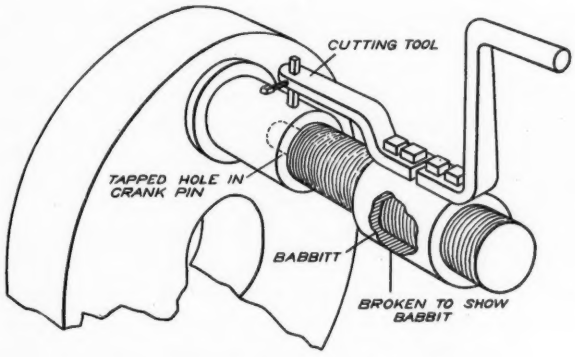
The compression ice plant recommends itself, because of its simplicity; its freedom from complicated chemical actions; its operation being based on ordinary mechanical principles well known to every competent engineer; its accessibility for examination and repairs; and its general reliability.

As soon as there is a recognized practise, much greater progress will be made in this line of machinery. This will be a great benefit to all owners and users of ice plants, for then you will get the benefit of the improvements and experience of all the engineers engaged in the work instead of depending, as you do now, upon the conclusions of the individual.

KINKS FROM THE ROAD

Truing a Rough Crankpin

In the American Machinist, H. W. Tyler gives his method of truing up the crankpin on a disk crank engine on which the pin had become cut, after the job had been given up by the manufacturers. A hole was drilled in the end of the crankpin and a piece of shafting tapped in so as to be in line with the crankpin. On this shafting, before putting in place, a thread was cut of the right pitch to give a proper feed for the



METHOD OF TRUING A CRANKPIN

cutting tool and a babbitted nut of sufficient length to run steady was made to turn on this thread. On the shell of this nut were bolted a tool holder and a crank for revolving the nut.

The whole affair was put together as shown in the illustration, the tool adjusted in the holder and the pin turned up. The pin, after being turned, showed out of round only 0.003 in. and, after rebabbitting the crankpin box and reboring it, the engine was started running without even scraping the box, and has been running ever since. The entire job, making the outfit, turning the crank, and all, took only 24 hr.

Etching on Steel

Often the engineer wishes to have his name on his tools, and it is certainly poor policy to stamp them.

To etch names on steel proceed as follows: Run a little bee's wax on the part to be etched, leaving it higher at the edges to form a rim to hold the fluid. Then with a sharp scratch awl write your name and cover the wax with the following:

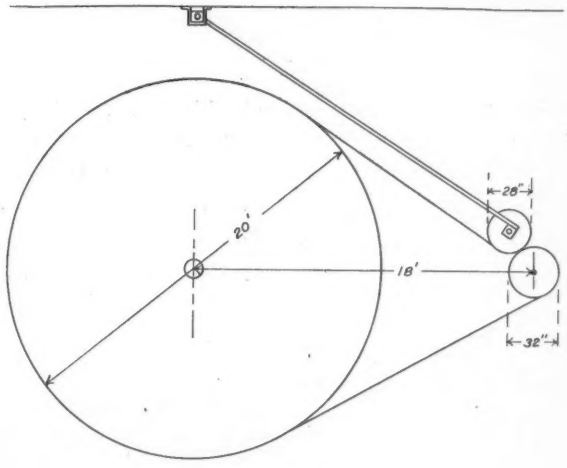
Pyroligneous acid, 4 parts; alcohol, 1 part by measure. Mix the 2, and then add 1 part double aquafortis. The longer the fluid is allowed to remain on the tool, the deeper it will etch the name. Usually, about 10 min. is sufficient. Tom Jones.

Covering a Pulley With Leather.

A cement made as follows may be used with great success, both for covering pulleys with leather and on belt joints before riveting. The leather will tear before coming off, if carefully done. Make an extract by digesting 1 part of coarsely crushed nut-galls with 8 parts of rainwater, let stand for several hours, and filter through linen. Then pour 1 part of cold water over 1 part of best glue, let it stand for 24 hrs., and heat to make a concentrate glue solution. To use the above, warm the nut-gall extract, and coat the leather with it. Warm the pulley, which should be roughened, and coat with the glue. Lay the leather on the warm pulley, press firmly together, binding it tightly with cord.—Technical World.

Belt Tightener for Exciter Drive

A method of putting a tightener pulley on a short drive which is likely to prove of convenience in a good many cases is found in the power plant of the Studebaker Works at South Bend, Ind. This is used to drive the exciter for the main alternating-current generator. The big generator is direct driven by Corliss engine and has a flywheel on the shaft. From the rim of this wheel, which is 20 ft. diameter, a belt is run to the exciter, which stands at 18 ft. centers. On the exciter shaft is mounted a 32-in. pulley and from the framework of the truss overhead a tightener pulley is hinged on a rod by means of a structural steel



A HANDY BELT TIGHTENER

frame so that it rests on the top of the belt. The idler pulley is 28 in. in diameter. The entire arrangement is compact, convenient and inexpensive.

Insulating Electricians Pliers

This is usually done by wrapping insulating tape around the handles. An improved way, which looks neater and gives better insulation and is also easier on the hands, is obtained by using ordinary rubber gas hose, which is slipped over the handles. If the hose does not slip on easily, a little powdered soapstone or soft soap may be used to secure the desired result. H. M. K.

LETTERS FROM ENGINEERS

Send us descriptions of ways of doing new things, and new ways of doing old things. Rough pencil sketches and letters are all right; we will fix them up for the printer. All accepted contributions will be paid for when published.

Why Does Engine Pound?

Editor Practical Engineer:

I have charge of an engine that has given me considerable trouble. It doesn't get hot, but pounds on both ends. The engine is a simple non-condensing 18 by 42 in., with a speed of 100 r. p. m., and supplied with 100-lb. steam. The engine runs quieter with late cutoff when carrying heavy load, such as is shown in

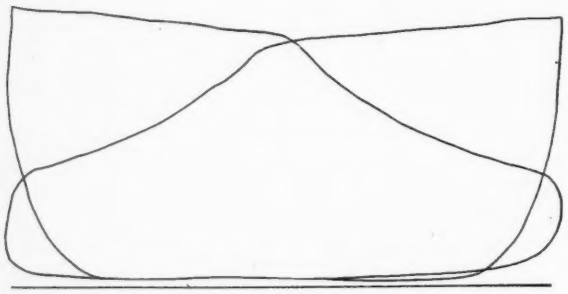


FIG. 1. HEAVY LOAD, NOISELESS RUNNING

Fig. 2, than when carrying the load in Fig. 1. I should like to hear from other engineers as to the trouble with the engine. A. R. M.

The above letter appeared in the August issue of Practical Engineer, and through an oversight the cuts were omitted. The letter is reproduced herewith.

Editors.

One Reason for Engine Pounding.

Editor Practical Engineer:

In reply to A. R. M., concerning the pounding of his engine, I would venture to say that his trouble is

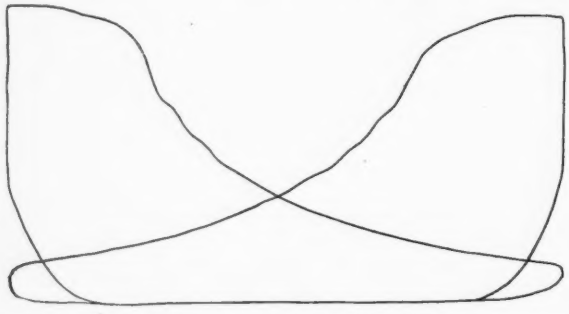


FIG. 2. LIGHT LOAD, ENGINE POUNDS

due to the boiler pressure being too high during the light load period, and thus causing the exhaust valves to slam, if it is a 4 valve engine, by reason of the steam expanding below the pressure in the exhaust pipe, due to an early cutoff.

It is easily understood that, if the pressure in the cylinder gets below the pressure in the exhaust pipe, the exhaust valves are liable to slam if there is any room for them to move up or down. It is considered good practise among the steam engineers of today, to allow about 20 lb. terminal pressure in a steam cylinder of a simple non-condensing engine; and getting back to the boiler pressure we find that this would allow little more than 80 lb. initial to the cylinder, depending on the condition of the piping.

This means that 4 expansions will take place, reducing the loss of condensation by keeping the cylinders at a more even temperature. This will balance the gain of a high initial pressure, resulting in an early cutoff and low terminal pressure which leaves a cool cylinder wall at the time of release.

William D. Dunbar.

The Safety Valve

Editor Practical Engineer:

In reply to Harry H. Yates, I would like to say that he could almost get along with 1 safety valve on the boiler he speaks of in the July issue of Practical Engineer, according to the laws governing the area of safety valves in Massachusetts.

Such a boiler would require a 4-in. safety valve according to the Hartford Steam Boiler Insurance Co., and also by the laws of the Board of Boiler Rules in Massachusetts.

The boiler in question evaporates approximately 4312.5 lb. of water an hour and 4312.5÷3600=1.19+ lb. a second; hence the rule, following: Water evaporated per second ×770÷ boiler pressure absolute=the area of the valve; for said boiler would be 9.65+sq. in., which would require a 4-in. valve, as nothing under the required area would suffice.

The result of this rule compares favorably with that of the rule used by the Hartford company or what Mr. Yates terms the French rule: 22.5×36÷80 +8.62=9.14 sq. in. W. D. Dunbar.

Pipe Boiler; Vacuum Heating

Editor Practical Engineer:

I should like to hear from the readers of Practical Engineer concerning the building of a small vertical boiler, to be composed of pipe and pipe fittings, for use in a launch.

I should be pleased to hear from engineers in

charge of vacuum heating systems, as to the troubles encountered, their remedy, and operation of the system. Samuel H. Winterbottom.

Safety Valve Area

Editor Practical Engineer:

Concerning Harry H. Yates' letter, relating to the area of safety valves, which appears on page 52 of the July issue of the Practical Engineer, I would say that if he will look in Kent's Mechanical Engineers' Pocket Book, under the heading of Safety Valves, he will find considerable that will probably be of interest to him relative to the subject.

It is likely, that if all who formulate rules for the proper area of safety valves, were familiar with a portion of the matter contained in Kent's Pocket Book there would not be quite so many different rules in existence to confuse those who are just entering an engineering career.

If Mr. Yates has read the passages referred to, then let him read them again, and think about them a few moments, and I think he will be able to form an opinion of his own relative to the subject.

For the benefit of those readers who may not have a copy of Kent's Pocket Book, allow me to make a few brief quotations, which will give an idea of how the matter may be looked upon, in a few particulars at least.

Referring to the rules in which the grate area is one of the factors, Kent says: "Then the English Board of Trade rule and Molesworth's rule would give an area of the disk of only 15 and 24 sq. in. respectively, showing the absurdity of making the area of the grate the basis of the calculation of the disk area."

Again—"A correct rule for the size of safety valves should make the product of the diameter and the lift proportional to the weight of steam to be discharged."

A logical method for calculating the size of safety valves is given in the July 1892, issue of "Locomotive" based on the assumption that the actual opening should be sufficient to discharge all the steam generated by the boiler. Napier's rule, for the flow of steam is taken, namely: The flow through an aperture of 1 sq. in. area in pounds per second which equals the absolute pressure divided by 70, or in pounds per hour equals 51.43 times the absolute pressure. If the angle of the seat is 45 deg. as specified in the rules of the United States Supervisors of Steam Vessels, the area of the opening in sq. in. equals the circumference of the disk multiplied by the lift times 0.71. The 0.71 being the cosine of 45 deg. or, the diameter of the disk times the lift times 2.23.

With small lifts, the area of the actual opening bears a direct ratio, not to the area of the disk, but to the circumference. Charles J. Mason.

A LITTLE KEROSENE added to the feed water is said to generally have a beneficial effect in case of foaming.

Dash Pot Repair

Editor Practical Engineer:

A short time ago, a young engineer of my acquaintance was running the plant in a large and progressive concern, and was called upon to set up another large engine in their already varied collection.

The engine in question was an old fashioned Greene automatic, and had acquired rather a bad reputation, having been installed in several different localities.

After my friend had arranged matters and the

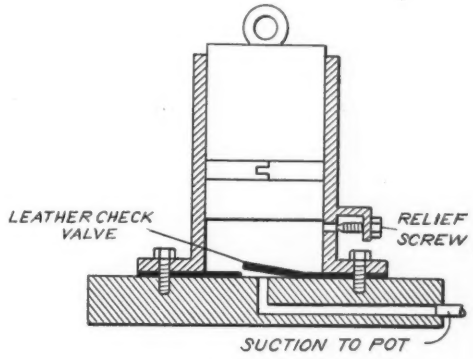


FIG. I. DASHPOT REPAIR

engine was put in operation, he experienced considerable trouble with the dashpots which were badly worn. As he could not induce the firm to put in new dashpots, he had to devise some method of repair. These dashpots were of the old fashioned type with a solid plunger, the valves being closed simply by dead weight.

This plunger when new was turned up to a nice moving fit in the dashpot, at the bottom of which was a leather checkvalve that controlled the air as follows: The dashpot stood on a cast-iron base plate. This base plate had a hole drilled in it from the side, and connecting with a vertical hole in the centre of the dashpot underneath the leather checkvalve. When the plunger of the dashpot was raised, it created a vacuum, causing the leather checkvalve to be raised, thereby admitting air to the dashpot.

When the valve was released and the plunger fell, thus closing the valve, this leather checkvalve was closed, thus retaining a portion of the air in the dashpot, and creating a cushion which prevented the plunger from striking the bottom with a bang.

At the side of the dashpot was a regulating screw to retain more or less air as required. These plungers were so badly worn that the air leaked out all around them, and they pounded on the bottom of the dashpot with a bad thump every time they seated. The regulating screws were of no use whatever, as they were entirely closed.

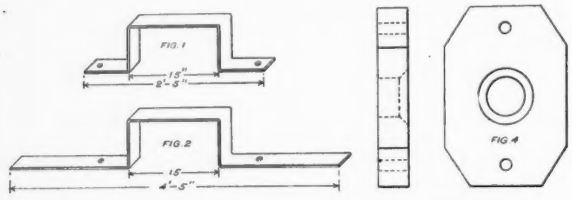
As there was a small lathe on the premises, run by another engine, the engineer took out the plungers and turned a groove in them at the centre as shown. As he had a pair of old pump rings of about the same

diameter as the plungers, he turned these grooves to just take these rings a good working fit. The rings were peened so that they were a trifle larger than the diameter of the interior of the dashpots, thus causing them to be slightly pressed together to enter them. When the engineer got the dashpots adjusted again, he found that they worked like a charm, and has had no further trouble, either from quick action or a noiseless working. C. H. T.

Evolving a Die Stock

Editor Practical Engineer:

Usually an employer can't see why an engineer doesn't have tools to go with his trade as well as a carpenter or brick mason, and will decline to invest $10 in tools that would, if properly used and cared for, last his plant a life time and save him 10 times their cost in the first 10 years.



FIGS. 1 AND 2. STRAP IRON BENT FOR DIE STOCK
FIG. 4. BUSHING FROM A PLANK

Now it has been the writer's lot more than once to find himself in a plant with nothing to repair piping except a few odd dies, a 12-in. monkey wrench and a hack saw. But an engineer, if he deserves the name at all, must be full of resources. The second place I struck was in an iron structural works where I had been called to investigate the reason for an excessive fuel consumption. I found it in the piping and lack of it!

This plant was partly equipped with pipe fitting tools and the main part that was missing was a stock for a 2-in. die. I was in a hurry, but as my eye lighted on a pile of 1.5 by ⅝-in. strap iron I was struck with an idea, and proceeded to develop it.

I took a length of the iron to a nearby forge and cut off a piece the right length and bent it to the shape shown in Fig. 1. Then cut another piece 2 ft. longer and bent it in the same manner, Fig. 2. Next I clamped the 2 pieces and drilled a 0.5-in. hole about 6 in. from the offset on each side, and placing a 2-in. die in the square formed by the 2 offsets I riveted the two pieces tight together, and the result is shown in Fig. 3.

Now I needed a bushing to guide the die straight. I saw a piece of pine plank lying idle and forlorn in a corner, so with the aid of a saw, small bit and jack knife I made a block like Fig. 4 and bolted it in place as shown at Fig. 5, and my emergency die stock was complete. I used it to cut 4 threads, gave the owner some good and much needed advice, advised the engineer to subscribe to Practical Engineer and returned to headquarters feeling well satisfied.

W. E. Chandler.

Getting Engineering Knowledge

Editor Practical Engineer:

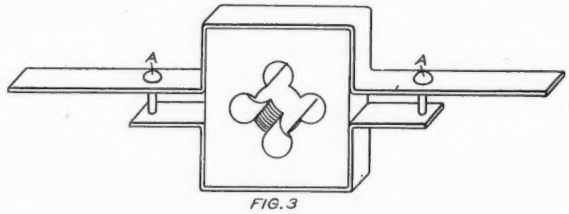
In the last number of the Practical Engineer there appears some excellent advice for steam engineers who are interested in their own welfare.

It seems to me it is a question of having the necessary knowledge, the matter of when and where it was acquired are matters of secondary importance to the examiner and to the employer as well.

The matter of how knowledge is acquired is not a matter of secondary importance to the individual however.

It is a matter of prime importance, which should have the most painstaking care and attention on his part.

In acquisition of all kinds, men strive to obtain the



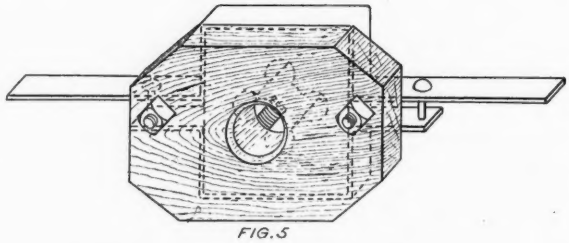


FIG. 3. MAKESHIFT DIE STOCK COMPLETE
FIG. 5. DIE-STOCK AND BUSHING

greatest amount, regarded both as to quantity and quality, in exchange for the least possible consideration.

A man's education constitutes his business capital in many cases just as certainly as money constitutes capital in other cases. Now, in the acquisition of wealth it is every man's aim to receive the greatest possible amount of money for the effort or commodity which he tenders for the consideration received.

There are many schools in which a man may receive his training, the character of the training and the price paid varying within wide limits.

The matter of simple engineering knowledge, which may be acquired in a half hour by reading a steam engineering journal, a good book, or in a half hour's time diligently devoted to study by the cor-

respondence method, under other methods requires years, and the price paid for it is measured in the loss of human life and the destruction of property.

It is hard work indeed for some men who have never had even an elementary training in mathematics to grasp ideas that need even common arithmetic for their proper understanding. It would seem that if some author would produce a work almost entirely devoid of mathematics for such men, it might result in doing much good for a class that should be posted in the rudiments of the science, even if they cannot be elevated to a higher plane.

The Natural Philosophy of steam engineering it seems could be treated without the use of mathematics at all, so as to reach a class that might be benefited to a certain extent by even the most rudimentary training.

There are a whole lot of steam engineers who could master what is for their decided benefit if they would only be up and doing.

The practical operating engineer who has the ambition to push himself forward and to supplement his practical experience with the technical knowledge that can easily be derived from steam journals and books on the subject of his profession can become a top notch man easily just as well as to remain at the bottom or be thrown out altogether when extension of the plant takes place.

There is absolutely no drudgery in obtaining knowledge in this manner, and what is learned in a few moments might take years in practice before it was discovered.

The license law is intended to exclude men from the practice of steam engineering who are not up to a certain standing in their calling.

Legislation on this subject as well as on all other subjects works both good and evil. It often keeps a good man out of the ranks and at the same time lets an incompetent man in. The writer knows personally a Massachusetts examiner who lays great stress on the practical knowledge which an applicant for a class license should possess.

Not that his examination is carried to a degree that would reveal such knowledge if it existed, but rather he is anxious to have the applicant make a statement showing that he has been employed for a long period or periods, and just what he has had charge of.

A statement of this kind (if true) shows that the applicant has been in positions perhaps for years where he has had an opportunity to learn if he had the natural ambition and the desire to do so.

It does not bring out what a man knows, for the real thing to ascertain is what the man knows, not how long he has attended the school of steam engineering.

An examination should be conducted primarily and solely for the purpose of ascertaining what knowledge there is in a man's head, and what skill his hands possess.

The matter of ascertaining how many years a man has been engaged in steam engineering, what he has had charge of, etc., and then making deductions as to whether he is eligible is, to say the least, a very impractical way of arriving at what a man knows.

This particular examiner, while he did not make the first examination in the case of a certain engineer, did issue the renewal of a first-class license to an engineer who at the same time was exploiting a scheme for putting the live steam of his exhaust back into the boiler by means of an immensely large pump, so that he could use the steam over and over again and thus economize in fuel.

Besides the experience and the knowledge which the engineer acquires in the routine of his daily work, the next most important avenue through which knowledge may come to him is the up-to-date steam journal, in which he can find an exposition of the principles underlying boiler and engine operation, together with letters giving the trials and troubles of his brother engineers, and their advice to each other.

The man who is not willing to leave it all to the editor, should remember that it is not all left to the editor, for the journal contains letters and communications from men of both practical and technical training, men who run small plants and men who run large plants and run them successfully at that, and if a query is answered wrong by the editor or by a brother engineer, nine times out of ten it will provoke comment from maybe twenty men who are competent to "knock the subject all to pieces."

Engineers, learn all you can in your boiler room, in your engine room; when a brother calls on you or when you call on him bore him, pump him dry for information, read your trade journals, and do not skip the hard parts, ask some member of the craft to give you a pointer, or write to the editor.

Remember that he only is wise who learns everywhere and from everybody, and make up your mind to be a "digit" at least, instead of "a big naught" which only serves to move your more ambitious fellow workman one place farther along the scale of dollars and cents.

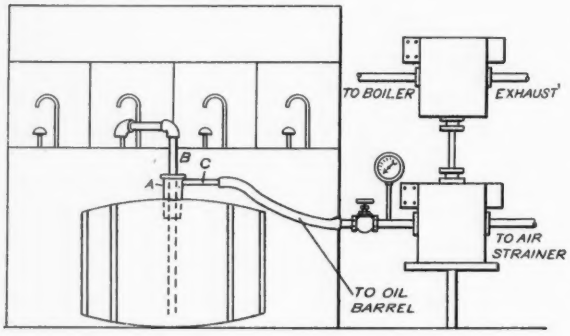
T. H. Reardon,

SEVERAL MONTHS AGO a 500-kw. Allis-Chalmers steam turbo-alternator unit, with a 15-kw. motor generator set for exciter was purchased by the Bisbee Improvement Co. of Bisbee, Arizona. The new unit was installed in the new power house of the Calumet & Arizona Mine, at Bisbee, together with a 160-kw. synchronous motor generator set which furnishes 240-volt direct current for cranes and slag locomotive when the turbine is operating, or it can be run by their old direct-current generator to supply a current for lighting purposes, when the turbine is idle. A 180-hp. motor is used to operate the mud mill and a 100-hp. motor drives the briqueting plant.

Trap in Vacuum Heating System

Editor Practical Engineer:

In regard to the question of location of traps in a vacuum heating system, I think it poor practice to place a trap between the vacuum pump and the heating coils, because in so doing you would render the pump practically useless as far as maintaining a vacuum on the coils is concerned. The vacuum then would be between the pump and the trap.



FORCING OIL FROM BARREL TO TANK

On the Webster System of steam heating there is placed on every radiator or coil a thermal valve which might be classed as a trap in itself. These valves are for the purpose of allowing the air and condensation to be drawn from the radiator and they close the instant the steam strikes them, thus allowing no steam to escape, so that none can enter the pump. A small jet of cold water is injected into he return line near the pump to reduce the temperature of the hot returns so that a vacuum can be maintained.

I am at present operating a Webster System carrying 15 in. of vacuum and have no trouble in keeping the building warm on the coldest days in winter with exhaust steam at atmospheric pressure.

N. S. Campbell.

Oil Pumping

Editor Practical Engineer:

At the plant where I am employed we used to have some trouble pumping the oil out of the barrels, especially in winter, but the oilers did not seem to relish the job at any time. So the chief made the rigging as shown.

A is a tapered bushing that screws into the bung hole of the barrel. On top of A is a reducing bushing, into which oil pipe B screws, and down through A to within a short distance of the bottom of the barrel. All one has to do is hitch the air hose to C, turn on the air at about 15 lb. pressure, and force the oil up through the oil pipe into the tank.

We had a few mishaps at first by putting a pressure on the barrel more than 15 lb., but we can regulate it now, and it works fine. I think all power stations where air is used to clean their machines will find this wrinkle worth while.

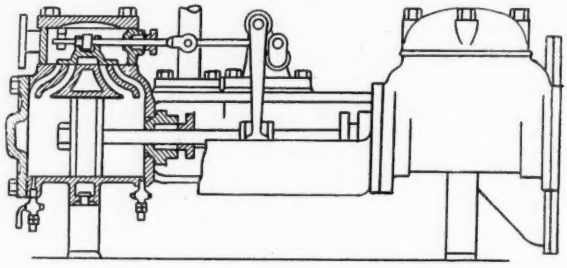
Thomas Sheehan.

SETTING VALVES OF DUPLEX PUMPS

Editor Practical Engineer:

I read with interest the article on page 38 of the April issue of the Practical Engineer as to why duplex pump valves have lost motion. The author of the article has a good deal to say about expansion and earlier cutoff, etc. Well, I have seen a large number of pumps, but have failed to see a duplex pump that did not admit steam the full length of the stroke. A pump valve should always be set to give full port opening. If the lost motion is too great the valve will not open the steam port its full width, and, of course, the pump would not work up to its full capacity.

As to expansion in a duplex pump, I fail to see where it comes in, for when the valves are correctly set the valve will open the width of port and remain open until the piston has about completed its stroke. If we did not give the valve lost motion, the pistons would both begin their stroke and end it at the same time, so 1 stroke would be all the pump would make, or if it did work at all, it would be very unsatisfactory. On a well designed pump you will notice that the valve stem travels about 3 times the width of the steam port, and as it is only necessary for the valve to travel twice the width of the port, we would then have lost motion equal to the width of 1 steam port.



DUPLEX PUMP VALVE SETTING

The way I always set the valves on a duplex pump is to set both pistons in the center of the stroke with both rocker arms in a vertical position. Then place the valves squarely over the steam ports and leave lost motion on each end of the valve equal to ½ of the width of the steam port. This setting should give full port opening and will also allow 1 piston to lead the other enough to insure quiet running. C. D.

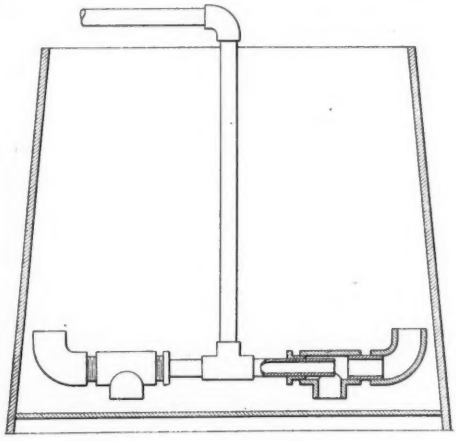
THE FUEL VALUE of the same weight of different woods is very nearly the same, that is, a pound of hickory is worth no more than a pound of pine, assuming both to be dry. If the value is measured by weight, it is important that the wood be dry, as each 10 per cent of moisture in the wood will detract about 12 per cent from its value as a fuel.

Heating Water by Steam

Editor Practical Engineer:

In a plant where I was employed as engineer there was need for quite a large quantity of hot water for certain purposes. A tank, 4 ft. diameter at the base, 3 ft. at top and 5 ft. deep, was placed in position for the work, and a straight piece of ½-in. pipe put down the center of the tank with a tee at the lower end a foot from the bottom of the tank.

When steam at 70 or 80 lb. pressure was turned into the tank filled with cold water, it would make a very disagreeable noise. Being asked for advice how the water could be heated and do away with the noise,



NOISELESS METHOD OF HEATING WATER BY LIVE STEAM

I suggested a galvanized iron coil placed in the tank and exhaust steam from the engine used to heat the water. The cost of the coil and necessary connections appeared to be too great an expense for the management, and another point, the water could not be heated in the tank if the engine was not running; also the water could be heated more quickly with the live steam in direct contact.

Having noticed that steam turned on a siphon ejector made no noise of any consequence, I set about applying the siphon principle with the steam to heat the water in my tank without the noise. I reduced the ½-in. tee to two short branches of ⅜-in. pipe, which were run through 2 ⅜ by 1¼-in. bushings screwed into the 2 1¼-in. tees and extending the ⅜-in. pipe a little beyond the center of the tee, then connecting a 1¼-in. ell to the tee by a short nipple, as seen in the illustration.

It will be seen that when steam is passing in a jet at the end of the small pipe in the large tee, the water will be drawn up from the bottom of the tank and upward at the sides through the ell and return to the bottom of the tank again down the center, causing a continuous circulation until the water reaches the boiling point. The noise formerly made in heating the water is now nearly eliminated and the sound made by the appliance when at work is not more than that made by an ordinary sized injector or a siphon ejector. Henry M. Statz.

Leaky Manhole Gaskets

Editor Practical Engineer:

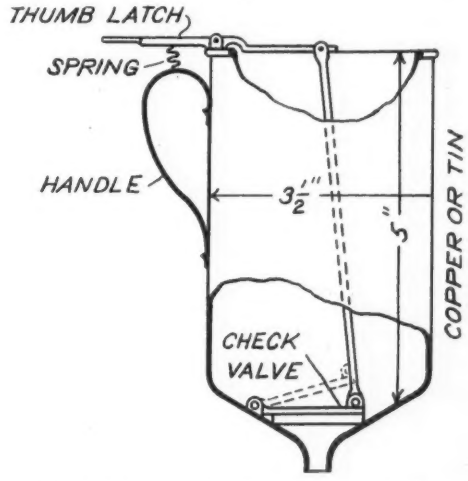
In the July issue of the Practical Engineer, I noticed an article by James Browning, in which he tells the method he uses in detecting a leak in the manhole gasket after washing out and refilling his boiler.

He says the boiler would have had to be killed had the leak not been discovered before getting up steam. There is no need of killing a boiler to put in a new gasket. After getting up steam should the top manhole gasket show any leak it is simply necessary to bank the fire, run the steam pressure down until the gage shows no pressure then put in a new gasket. Sam Cunningham.

Home Made Oil Can

Editor Practical Engineer:

I send you with this a drawing showing a novel oil can, which I have made and find very convenient. The barrel and neck of the can are made of sheet copper. For the seat of the valve in the neck I used



CAN FOR FILLING SIGHT-FEED OIL CUPS

a piece of brass pipe, and for the valve itself a leather disk fastened to a brass hinge. The latch, which runs up to the top of the can, is made of 0.25-in. wire. After an engineer has once used this can for filling glass oil cups and bearings he will never go back to the ordinary kind. R. E.

In comparison, 57.25 lb. of coal or 63 lb. of coke are equal to about 1000 cu. ft. of natural gas. Producer gas made by the partial combustion of coal to carbonic oxide is a lean gas composed of about 25 per cent CO and about 60 per cent of nitrogen. The calorific value is about 150 B. t. u. per cubic foot.

A STEAM TURBINE DRIVEN PAPER MILL

Just outside of Coatesville, Pa., in a little valley where fresh air and pure water are more easily secured than in a city, the Megargee Paper Mills have recently completed and placed in operation a new mill for the manufacture of water leaf paper for parchmentizing. For the purpose intended, this is in all probability the most up-to-date paper mill in the world.

A brief description of the process will be especially interesting to readers of an engineering paper.

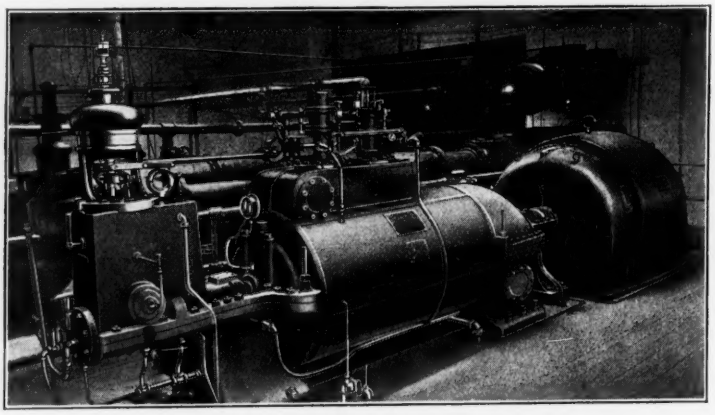


FIG. 1. WESTINGHOUSE TURBINE AND GENERATOR IN THE MEGARGEE PAPER CO.'S MILL

The rags, for rags only are used, arrive in bales weighing several hundred pounds each. These are partly broken up by hand and thrown into the "thresher," which in appearance much resembles a grain thresher. This machine separates the rags, and knocks out most of the dust, which is carried off by a suction draft.

From here the rags are carried on a canvas apron carrier to the assorting room, in which women and girls pick over the rags, chopping off the buttons, buckles, and other undesirable materials.

After inspection by the forewoman, they go to the cutters, which contain 2 sets of blades, acting at right angles, so that the rags are chopped into little squares about an inch wide and long.

Every act of handling and picking the rags is done over wire screens, through which an air blast sucks the dust away from the operatives, so that the rooms, which would otherwise become so dusty as to be injurious to health, are kept clear and comfortable.

The next operation is in the duster, where a powerful blast of air takes out the last dust particles and prepares the rags for boiling.

Three boilers, each 20 feet long by 8 feet in diameter, are arranged so as to revolve slowly during the boiling process. Each boiler holds 10,000 lb. of rags, besides the necessary mixture of water and chloride of lime, in which the rags are boiled for 12 hours under 40 lb. steam pressure. This starts or loosens very effectually the grease and coloring matter, so that upon arrival the original collection of varicolored rags has changed to a uniform brown mass.

Next, the rags go to the washing engines, of which there are 6, each of 2000 lb. capacity, and equipped with knives for grinding the rags into pulp. These washing engines consist of a large annular tank around which the pulp is forced unceasingly for 9 hours. All the time fresh water is running in and being drawn out through screens of wire cloth, so closely woven that not even the finest pulp can pass through it. Also the knives are continually grinding and being set closer together, so that on leaving the washers the pulp is snowy white, and to the novice, apparently fine enough for the rolls.

But it must yet be passed through the beaters,

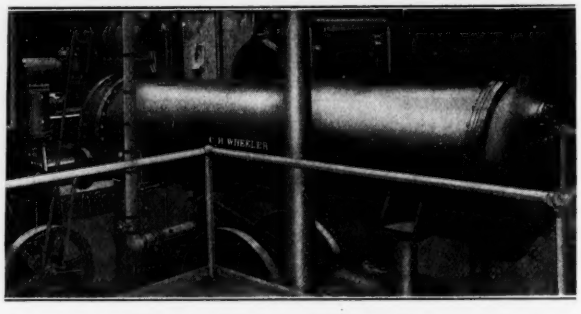


FIG. 2. CONDENSER AND EQUIPMENT MADE BY THE C. H. WHEELER MFG. CO.

where for 3 hours it is cut finer—next, through the Jordon engines, which reduce it to a fineness scarcely imaginable, before going to the real paper making machines.

These machines, partly shown in Fig. 3, are made at Wilmington, Del., by the Pusey-Jones Co. Each one is about 100 ft. long, 7 ft. wide and 10 ft. high, and contains besides a great many complicated devices for regulating the flow and spread of the pulp, 11 steam-heated rolls, 6 ft. wide, and 48 in. in diameter.

The pulp flows in at one end as a liquid and emerges from the other as the finest finished parchment paper, rolled, and ready for delivery. Each of the 2 machines has a capacity of 15,000 lb. of paper daily.

The engine room of this mill is no less modern in its equipment. This is one of the first paper mills to be driven by a steam turbine, which is of the Westinghouse Parsons type, Fig. 1, and direct connected to a 775-kw. alternating-current generator. This has a 60-cycle 3-phase winding, and delivers current at 440 volts.

The thresher, boilers, washing engines, beaters, Jordon engines, pumps, fans, etc., are all motor driven or driven from line shafts, which in turn are motor driven with the power received from this generator. Each of the 2 paper machines, however, has its own steam engine, the exhaust from which goes to heat the rolls.

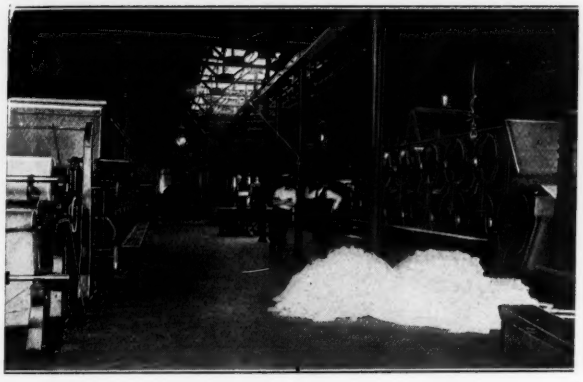


FIG. 3. THE BIG PUSEY-JONES PAPER MACHINE

The efficiency of a steam turbine is of course almost entirely dependent upon a good condensing apparatus, and this has here been secured, with the C. H. Wheeler surface condenser, as shown in Fig. 2. This condenser contains 2300 sq. ft. of cooling surface; circulating water is supplied by a centrifugal pump, direct-connected to an 8 by 9-in. marine type engine; the air pump is an 8 by 16 by 12-in. Mullan horizontal crank and flywheel suction valveless type. The entire outfit is the product of the C. H. Wheeler Manufacturing Co., of Phialdelphia.

At the time of our visit, with an initial circulating water temperature of 74 deg. F., the condenser was maintaining a vacuum of 28.5 in.

The efficiency of the Parsons turbine could not be determined, owing to the lack of facilities for making a test, but under such favorable conditions it must have been exceptionally high.

FRICTION OF LIQUID in pipes increases as the square of the velocity.

TO FIND THE SIDE OF AN EQUAL SQUARE, multiply the diameter of a circle by 0.8862.

THE HYDRAULIC RAM

THE hydraulic ram is the simplest mechanism for the elevation, and forcing of water from a given height to another, and is one of the most efficient motors operated by water for this work. The parts are few in number, simple in construction, not liable to derangement, and the ram requires little attention.

Construction and Operation

The hydraulic ram consists of a supply pipe through which the water enters the ram; the discharge pipe 2, is connected to a suitable opening at the base of the air-chamber 5, which conveys the water to the desired place. The waste-valve 3, allows the stroke

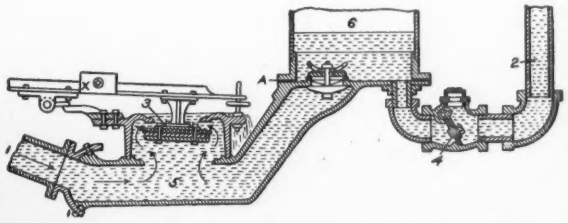


FIG. 1. SECTIONAL VIEW OF HYDRAULIC RAM MECHANISM

of the ram to be regulated, and also allows of an overflow to start the body of water in motion, and develop necessary power to operate the ram.

The check-valve 4, retains the water after its passage through the air-chamber 6, into discharge pipe 2. The main chamber 5, is the receptacle into which the water enters. The air chamber 6, is to allow the entering air to rise to the highest point, and being compressed, cushions the impact of the entering water. The air also assists in reversing the direction of flow of the column of water, prior to each stroke.

The operation is as follows: The valve 3, being open, the water from the supply pipe, entering under a head, flows into the main chamber 5, and out the waste-valve 3. This continues until the velocity of the entering water is sufficient to close the waste-valve 3.

At the instant the flow through the valve 3 stops, the inertia of the moving column of water produces the so-called ramming stroke; that is, it opens the check-valve A, compressing the air in chamber 6. The water during this time passing out the discharge pipe 2 to the desired point.

This continues, until the air pressure, plus the pressure due to the head of water in the main, is sufficient to overcome the intertia of the moving column of water in the supply pipe 1, when the check-valve A closes.

The water in the supply pipe 1, moving backward, with the closing of check 4, tends to create a partial vacuum at the base of the supply pipe 1, in the chamber 6. The partial vacuum causes the check-valve 3, to open, when the preceding cycle of operations is repeated indefinitely.

At the instant the partial vacuum is formed, a little snifting valve opens inward, admitting a small volume of air, which on the following stroke, passes into the air-chamber 6. The admission of air at this point is necessary, otherwise the air-chamber would fill with water, since the water gradually absorbs the air.

Losses

The loss in a hydraulic ram arises from water friction, resistance offered by the check-valve, from loss of water during and after the closing of the waste-valve 3. This loss is variously calculated at from 15 to 25 per cent, depending upon the construction and adjustment of the waste-valve 3.

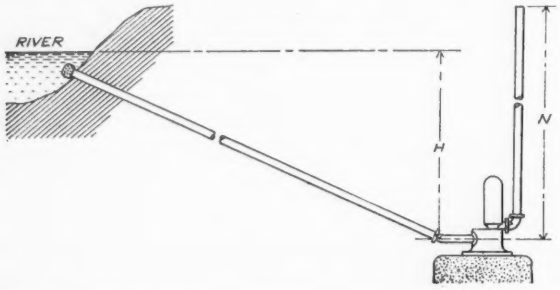


FIG. 2. DIAGRAM ILLUSTRATING FORMULAS FOR HYDRAULIC RAM

When the waste-valve 3, begins to close, there is resistance offered to the entering water; and from that time, until the check-valve 4 opens, no useful work is performed: The water escaping during this time is wasted.

Starting

First, place the weight X, over the center of the rod used to balance the waste-valve 3, securely fastening it. Then raise and lower the valve stem lever, by means of the nuts on the stem. This regulates the opening of the waste-valve 3, and graduates the volume of water used and delivered by the ram.

The greater the number of strokes the ram makes in a given time, the less the volume of water delivered.

The smaller the number of strokes, the greater the volume of water delivered in a given time.

Installation

When a large quantity of water is to be elevated, or forced a reasonable distance, the ram should be placed at a level of 2 or more feet below the surface of the water supplying the ram. A suitable drain must be provided to carry off the water used as power in the ram.

The ram should be set level both ways, on a firm foundation of sufficient area to prevent settling. The drive pipe, or pipe supplying the water, should be laid on a straight incline, without bends, except where it enters the ram. The pipe should be submerged at least 1 ft. in the water to prevent the admission of air; a good strainer should also be secured to the upper end of the pipe. In practice, if the drive head is small, a larger pipe should be used than where the head is greater, to reduce the friction. For ordinary conditions the head of water to the ram should not exceed 12 or 15 ft. If the head is greater, it must be reduced.

The delivery pipe can be laid with bends if necessary, care being taken to have all bends of large radius.

Calculations

The simplest method of calculating the amount of work that may be expected of a ram is, to consider the amount of energy available to do the work, and the amount of work to be done. The latter, must include all the friction loss, for which it is usual to add 1/3 of the required work to the total work.

Rules for the performance of the ram are as follows:*

1. To find the number of gallons of water raised in 1 min.; multiply the number of gallons of water available for power, by the head in feet, and this by 2; divide by the height in feet to which the water is to be elevated multiplied by 3.

Example: If 2500 gal. of water are available, under a 30 ft. head, and the water is to be elevated 75 ft.. how many gallons can be raised?

$$\text{Operation: } \frac{2500\times30\times2}{75\times3} = 666\ 2/9 \text{ gal.}$$

2. To find the number of gallons that should be available to elevate a given number of gallons per minute, multiply the number of gallons to be elevated, by the height of the elevation and by 3; divide the product by the head in feet acting on the ram, multiplied by 2.

Example: How many gallons should be available to elevate 2000 gal. of water 25 ft. under a 15 ft. head?

$$\text{Operation: } \frac{2000\times25\times3}{15\times2} = 5000 \text{ gal.}$$

3. The required head to elevate a given number of gallons is found as follows: Multiply the number of gallons to be raised, by the number of feet it is to be raised, and this multiplied by 3, divide this product by the number of gallons available, multiplied by 2.

Example: What head is required to elevate 3550 gal. of water 20 ft. when 6500 gal. are available?

$$\text{Operation: } \frac{3550\times20\times3}{6500\times2} = 16\ 5/13 \text{ or } 17 \text{ ft. head.}$$

---

*In the form of formulas:
Q equals the gallons of water available.
H equals the head acting on the ram.
q equals the gallons of water elevated or discharged.
N equals the number of feet the water is elevated.

1. q equals $2/3\ \frac{Q\times H}{N}$
2. Q equals $3/2\ \frac{N\times q}{H}$
3. H equals $3/2\ \frac{N\times q}{Q}$
4. N equals $2/3\ \frac{Q\times H}{q}$

4. To find the height to which a given number of gallons of water can be elevated, multiply the number of gallons available, by the head in feet, and this by 2. Divide this product by the number of gallons to be raised, multiplied by 3.

Example: To what height can 3250 gal. of water be elevated, when 6500 gal. are available under a 14-ft. head?

$$\text{Operation: } \frac{6500 \times 14 \times 2}{3250 \times 3} = 18+\text{ft.}$$

A NOVEL AND IMPROVED INDICATOR REDUCING MOTION

It is probably well within the bounds of accuracy to state that 9 engineers out of every 10 would take indicator cards more frequently and profit by the results of such constant diagnosis of the inside workings of the engine, if it were not for the trouble and delay which is involved in taking indicator cards from the average engine. Methods have been devised by the score for reducing the motion of the cross head, but many of these are systems of levers, quite unsightly in appearance and more or less cumbersome, which no engineer wants to leave on his engine ready for use at any or all times.

The reducing wheel is about as simple and compact as anything could be, but it involves 2 decided disadvantages. The first is the difficulty of securing a correct transfer of relative motion through the more or less elastic and highly flexible string, and the second is the by no means simple task of hooking the string to the moving crosshead when it is desired to take cards.

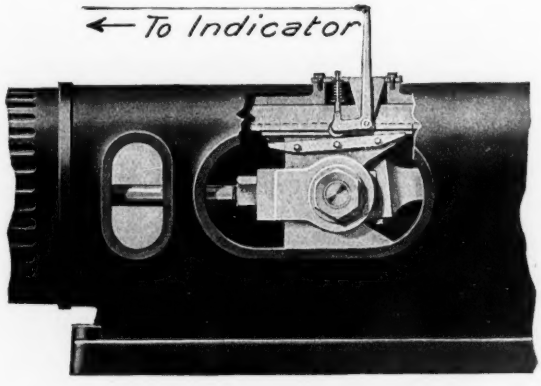


FIG. 1. BALL REDUCING MOTION IN PLACE

In view of these conditions the reader will be interested in a new and improved indicator reducing motion, on which patent has been lately applied for by Messrs. F. H. and F. O. Ball of the American Engine Co., Bound Brook, N. J., and which is seen for the first time as one of many novel and complete details of the new American-Ball Angle Compound. There exists no physical reason why this indicator rig should not be applied to other engines, inasmuch as its design and construction involve no features which prevent its use on Corliss or any other type of reciprocating engine.

Fig. 1 shows the complete rig in connection with the crosshead. It will be seen that the device consists of a slotted plate through which moves an L shaped lever. At the elbow this lever is pivoted through a bolt, at the apex of a triangular slotted plate cast as one with the outer plate of the device, and at right angles to it.

The short arm of the L shaped lever is forked. In the fork is set, by means of a pin, a small wheel or roller. Also connected with this arm is a pin which works through and at right angles to the outer plate. A helical spring, pressing against the outer plate and a disk resting on the shoulder of the pin, constantly

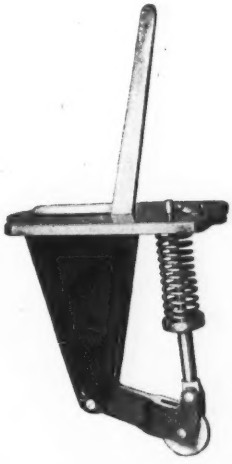


FIG. 2. ENLARGED VIEW OF REDUCING MOTION DETAILS INDICATOR DIAGRAMS

tends to maintain the L arm at the extreme end of the slot. The device is fastened by bolts to the frame of the engine.

On the crosshead is secured, by means of bolts, a cast-iron cam plate or slide set at an angle in the vertical plane with the lower end directed away from the cylinder and at such an angle that the lower or front end is 2 inches below the rear end. The angle of this cam plate is determined by the length of the stroke of the engine, so that the same difference in height between the front and rear ends of the plate will be preserved in all cases.

When the cross head is in position nearest the cylinder, the lower end of the cam plate or slide attached to the crosshead is in contact with the wheel or roller at the lower end of the L arm, and as the crosshead travels forward this wheel or roller with its arm is raised in exact proportion to the piston travel, against the pressure of the spring, the reverse taking place as the crosshead returns. The strength of the coiled spring is sufficient to prevent any lost motion with this device, even in a high-speed engine.

The adjustment of the cam plate can always be so arranged that the travel of the upper end of the L arm is exactly that desired to turn the indicator cylinder the required distance without further reduction.

Referring to Fig. 2, it will be seen that on top of

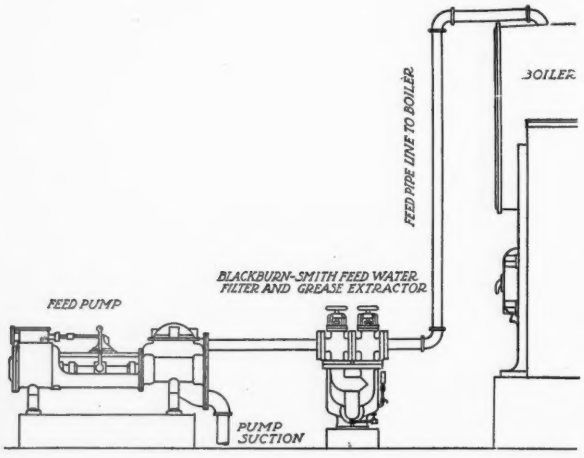


FIG. 1. FILTER CONNECTED IN PUMP SUCTION LINE

the exterior plate is a small flat trigger or lock which engages with a slot milled into the spindle or pin working in and out through the plate. Thus when the pin is pushed to its extreme top position, the trigger can be slipped into the slot and the rig instantly thrown out of engagement. It is the work of but an instant to release the trigger and throw the indicator rig into service.

As far as the exterior appearance of this rig is concerned, the only visible portion is a highly polished oblong metal plate on the engine frame with a slot through which projects a 6 or 7 in. lever with a hole in the top. The indicator cord may be kept constantly attached to the lever and cards taken continually, if so desired, or the rig thrown in and out of service as many times as desired.

FEED WATER FILTRATION

Filtration of feed water through separated layers of linen terry is generally conceded to be the best filtering process, for by eliminating hay, burlap, and charcoal filtering beds, the labor and cost of maintenence for the filtering system is reduced to a minimum.

Linen terry is the filtering medium employed on war ships of the American, British, German and other navies and is almost uniformly used in marine work; where on account of the limited water supply, the highest possible filtering efficiency is essential.

Besides removing oil from condensation, filters are also excellent for collecting mud, sediment and slime in the water, and will do this work more effectively than elaborate settling tanks or basins. They save a great deal of space, are less expensive and are infinitely easier to clean than such basins.

We illustrate the Blackburn-Smith feed water filter and grease extractor, a device which is installed in the feed line, and subjects all entering water to double filtration through separated terry cloths. If an open heater is used, this filter is placed between the pump and the boiler, but if the heater is of the closed type, the filter should be installed between pump and the heater, in order that the suspended particles will

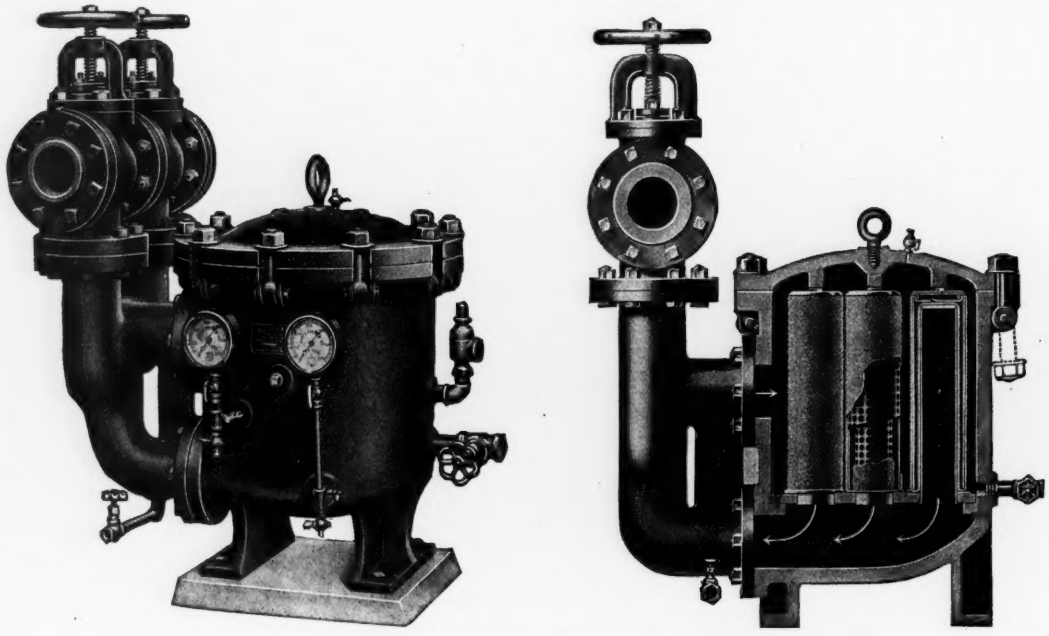


FIG. 2. OUTSIDE AND SECTION OF THE BLACKBURN SMITH FILTER

be caught before they can settle on and reduce the efficiency of the heater surface.

The filter, so installed, is very effective in removing mechanically suspended particles from the water supply, for removing all particles of oil, grease and dirt from the water. By removing the scale-forming matter the filter makes repair bills less, reduces the coal bills, and effects a marked saving in water bills due to the use of the condensation of exhaust steam.

The filter costs practically nothing for up-keep as the terry cloth can be cleaned and used over and over.

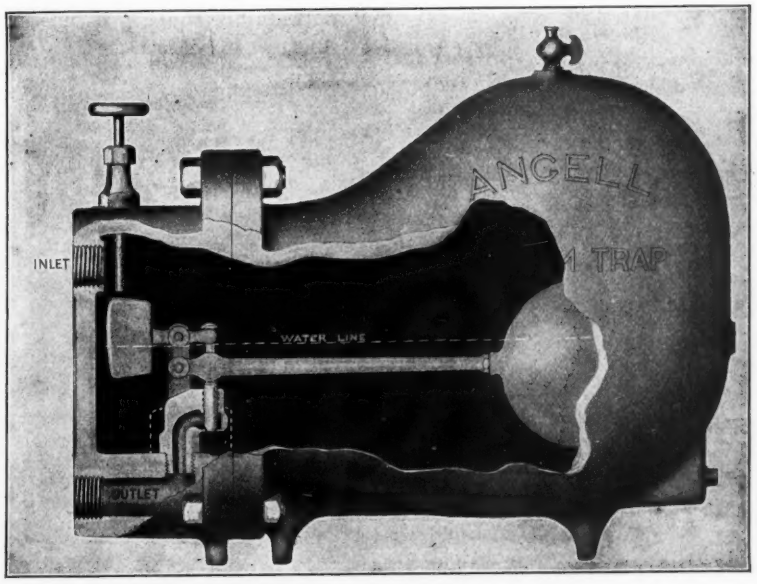
Referring to the cross-section, water from the feed pump enters the inlet, passes into the upper or filtering chamber through the filtering cartridges, into the pump chamber, and thence from the outlet to the closed heater or boiler.

THE ANGELL STEAM TRAP

The steam trap, manufactured by The Angell Mfg. Co., Rochelle Park, N. J., is shown herewith.

This trap is simple in construction. By introducing a long-shank valve-stem, the weight lever acts with the float lever in lifting the valve. As soon as the valve starts to open, the weight lever acts independently by lifting it wide open. While the trap is discharging, the weight resists any tendency of the valve to close, thus preventing the shock of full steam-hammer on the valve seat.

As the float operates up and down, the valve, which is free to turn, is revolved. The outlet, being low, is water-sealed and the valve which is a single-seated balanced valve, is protected by a screen against all sediment. There is only 1 valve.



THE ANGELL STEAM TRAP.

The water passes through the cartridges with little friction, but in the course of time, as the foreign matter accumulates on the filtering material, some resistance will result. This resistance is shown by the reading of pressure gages, see exterior view connected to the filtering and outlet chambers. When the difference of pressure as shown by the gages increases to 20 pounds per square inch, the filter should be cleaned. A water relief valve automatically prevents the building of excessive pressure in the pump discharge line.

An occasional opening of the air cock located near the center of the cover will prevent the accumulation of air in the filter before carrying it into the boilers.

The Blackburn-Smith filter is made by James Beggs & Co., 109 Liberty st., New York.

The pressure on the valve, when closed, is greater than the resistance of the weight lever opposing it, and the incoming water, raising the float lever, starts the weight lever on its upward movement, opening the valve, closing it on its return movement. The water discharges between the valve and the valve seat, and does not pass out along the body of the valve casing; therefore, the outlet is of the same area as the valve.

The trap acts intermittently when sufficient condensation is flowing, and only at high pressure; when the pressure on the area of the outlet becomes equal to the resistance of the weight lever, the intermittent action ceases, which occurs at a pressure of about 40 lb. Low-pressure traps are of the continuous-flow type.

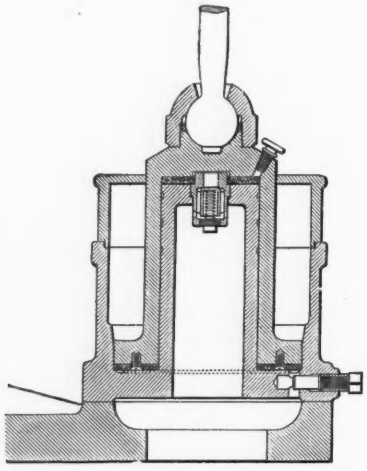
QUESTIONS AND ANSWERS

Our readers are invited to send in their troubles and problems; also to answer questions which are asked. All letters must have name and address of writer, which will not, however, be published. If answers are wanted by mail, send stamp for reply.

Action of Dashpots

G. F. L.—Please explain the action of the dashpot of a Corliss engine. Is the suction formed by a vacuum, or by the action of oil?

A. In the operation of the Corliss engine dashpot, the resistance offered the hook of the Corliss valve gear when opening the steam valve is due to the unbalanced air pressure on top of the dashpot plunger. When the plunger is raised and allowed to fall it drives out a large portion of the air beneath, a certain quantity of air being entrapped to form a cushion, thus preventing the plunger from striking the bottom of the cylinder. The air is driven out through a check or regulating valve, and when the plunger is again raised a partial vacuum is created beneath it, the pressure of the atmosphere forcing the plunger downward as soon as the hook releases the drop rod. The



SECTION OF CORLISS DASHPOT WITH REGULATING VALVE AT BOTTOM

degree or extent of cushion is regulated by means of a small valve shown in the side of the cylinder at the bottom which during the ascent of the plunger admits a small quantity of air, but not enough to destroy the vacuum; the surplus air is driven out through the check or regulating valve when cushioning the plunger. By this means both the vacuum and cushioning effect are kept at a constant value.

Position of Cutoff Eccentric; Pumping Water

A. H.—I am running a tandem compound duplex pump. I notice that there are no stuffing boxes on the piston rod between the high and low pressure steam cylinders.

What prevents the steam from leaking through? 2. What relation is the eccentric that operates the cutoff to the crank on a Nordberg Corliss engine? 3. Can you pump water out of an air-tight tank, located 10 ft. above the pump? 4. What is the hottest that water can be successfully pumped into a boiler where the water enters the pump at a pressure of 20 lb. at 200 deg. From the pump it then passes through a Baragwanath closed feed-water heater. Around the tubes is 5 lb. pressure of exhaust steam. steam.

5. What proportion are the cylinders on a triple compound engine, where the high-pressure cylinder is 25 in. diameter?

A. 1. Frequently a tube is used instead of stuffing-boxes between the high and low pressure cylinders of both engines and pumps. The tube is bored to a working fit on the rod, and is provided with a number of water packing grooves on the inner side which prevent leakage.

2. The position of the cutoff eccentric of the Nordberg Corliss is substantially the same as the crank, the eccentric being only a few degrees in advance of the crank.

3. Water can be pumped out of an air tight tank until the vacuum in the tank becomes equal to that which the pump would be capable of producing were it to lift water from a well.

4. The maximum temperature of water which can be successfully handled by a pump usually is from 6 to 8 deg. lower than the boiling point corresponding to the pressure. The boiling point of water under pressure of 20 lb. is 259 deg., therefore a pump in good condition can handle water at a temperature of 250 to 254 deg. provided the delivery pressure is as high or higher than the suction pressure.

5. We are not certain to what you refer by the term triple-compound engine, whether you mean a 3 cylinder compound or a triple expansion engine. Since 3-cylinder compounds are seldom used for stationary purposes we assume you refer to a triple expansion engine, in which case the cylinders would be 25, 40 and 64 inches in diameter.

Charging Storage Battery With Mercury Arc Rectifier

H. O.—Assuming that a storage battery takes 40 amperes current at 110 volts and is charged in 8 hours, what will be the cost of charging at 8c per kilowatt-hour or using a mercury arc rectifier? How will this

compare with the charge for direct current? What is the per cent of efficiency of the battery?

A.—To begin at the end of your question, the efficiency of the mercury arc rectifier is about 82 per cent. The kilowatt hours required to charge your battery would be $40\times110\times8\div1{,}000$ if the efficiency were 100 per cent. With an efficiency of 82 per cent the kilowatt hours required would be the value just given divided by 0.82, or 42.9. The cost of this at 8 cents per kilowatt-hour would be $3.43. The cost for charging from a direct-current circuit would be 82 per cent of this, because the loss in the rectifier would be eliminated, or $2.81. The efficiency of the storage battery calculated from the watt hours input to the watt hours output would be practically 80 per cent if charged and discharged at the 8-hour rate.

Advantages of the Corliss Engine; Lap of Valves

F. A. G.—What would be the least amount of lap on a Harris-Corliss Engine, equipped with a single eccentric, and still maintain the proper lead and compression?

What is the advantage of the Corliss Engine over other engines, equipped with automatic governor?

A.—1. You understand that in a Corliss engine the lead does not depend upon the lap as it does in the case of the D Valve. The amount of lap given to the steam valve is usually what is considered necessary to make a steam tight joint and the lead is, of course, governed by the eccentric position. If the lap is small, the angle of advance can be small and still give the proper lead, but this will mean that release and compression will both come late. Release can be made earlier by shortening the exhaust valve link, but this will make the compression still later. In a 20 by 48-in. engine, satisfactory running can be secured with ⅛-in. steam lap and 1/16 in. exhaust lap. The exhaust lap is all right for steady running, but we should rather have the steam lap ¼ in. for steady work, for ⅛ in. is apt to get leaky after 2 or 3 months. With regard to the small amount of exhaust lap, this is done to give as late compression as possible and have the engine run quiet. With 1/16 in. exhaust lap, compression will begin at about 2.5 in. from the end of the stroke.

2. The Corliss valve and wrist plate motion gives a sharper opening of the valve, a longer dwell when open and sharper closing than any other motion that has been invented. It is also a motion which is easily got at for adjustment or repairs and has as little complication as any and less complication that most drop cutoff gears.

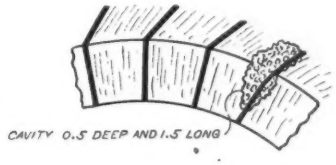
Why Safety Valve Seats are Beveled

S. J. B.—Why are safety valves made with seats beveled at an angle of 45 deg?

A.—The seats are beveled so as to permit the valve to seat exactly in the same place or position without the necessity of having closely fitting guides or guide stems. It also facilitates fitting the valve to the seat, since the valve is automatically centered on the seat and, furthermore, the valve may be refitted a number of times by grinding or being turned in a lathe without weakening either the valve or the seat. Inclining the edges of the valve at an angle of 45 deg. affords free passage for the steam, since the current of steam is not turned abruptly when passing between the valve and the seat. If the angle were greater than 45 deg., the lift of the valve corresponding to a given area for discharge would be greater, and the force of the blow, when seating under pressure would, therefore, be more severe, and if the seat be wide the tendency to stick would be greatly increased.

Mending a Commutator

Can any reader recommend a filling to go between 2 segments of a commutator of a Westinghouse dynamo of 250 volts 90 amperes. The cavity is near the



outer end of the segments, and has caused no trouble except the dust burning out. Cavity is about ½ in. deep and 1½ in. long.

Is there any substance to fill the hole or some way to repair it besides putting in new segments?

J. E. G.

Electric Water Heater

L. R. I.—How can I make an electric water heater for general uses around a sub-station, such as washing overalls, toilet, etc. The maximum amount of water to heat at 1 time would be from 12 to 15 gals. for washing overalls. The voltage of our system is 110, alternating current at 60 cycles per second.

A.—Taking 15 gal. of water to be heated in 30 min. you would have then 123 lb. If this is to be heated from 50 deg. to 212, you will have 172 B. t. u. per pound to be added, or a total of 21,100 B. t. u. This will require to be added $21{,}100 \div 30 = 708$ B. t. u. per minute. To get the amperes required multiply this by 778 and divide by 33,000 to find the horsepower, then multiply that by 746 to get the watts and divide by 110 to get the amperes, which gives 113.5 amperes. This would require a power consumption, then, of $113\times110=12.4$ kw.

The resistance to be put across the mains and immersed in the water would be $110 \div 113.5 = 0.98$ ohm. This could be secured by winding a strip of tin on a wood frame and immersing the whole thing in a barrel of water; but after all is said and done it is rather an uneconomical way of heating the water.

BRACING BOILERS

THE proper bracing of steam boilers is receiving the attention of engineers and the insurance companies to a greater extent than formerly, especially as modern practice tends to larger units and higher pressures.

Internal pressure, in a vessel, acts equally in all directions from the center.

Surfaces Requiring Bracing

If it was practical to build boilers spherical, no braces would be required, as the form is self-supporting. Since such is not the case, surfaces that are not self-supporting must be braced.

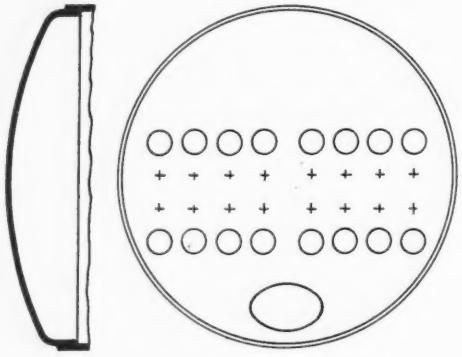


FIG. 1. BUMPED HEAD

When the construction of the boiler is such that the parts do not contain flat surfaces, no braces are required. For instance, the bumped head, which is formed convex from boiler plate by dies, partakes of the spherical shape to such an extent that no braces are required, when the head is bumped at the proper radius. This is shown in Fig. 1.

Some water tube boilers are composed of cylindrical drums, with bumped head, the headers, their nipples and the tubes, with no flat surfaces of any area to speak of; in such cases no braces are required.

In return tubular boilers, the surfaces requiring bracing are the upper portion of the heads above the tubes, and with some tube layouts a small portion of the heads below the tubes.

When the boilers are fitted with domes or drums, which is seldom done in up-to-date practice, the head of the drum needs bracing.

Types of Braces

In reality there is no difference between a stay and a brace, both are for the same purpose. When the stays are short, say not over 8-in. long, such as used in the water legs of internally fired boilers, they are called stay bolts, and the name stay clings to the longer ones, although the term braces is used for the longer ones also.

Figure 2 shows a form of stay bolt as used in supporting the inner sheet in an internally fired boiler with a water leg. It is a short piece of iron or steel, threaded on each end, a sufficient distance to screw through the thickness of the sheets composing the sides of the water leg, as shown in Fig. 2. The ends are riveted over as shown.

Sometimes the stay bolt is threaded its entire length; this is not considered good practice, since the cutting of the thread disturbs the surface of the metal, exposing it to the corrosive action of the impurities in the feed water.

At one time, when the stay bolts were threaded their entire length, a sleeve was put over the stay bolts between the sheets, to protect them from the

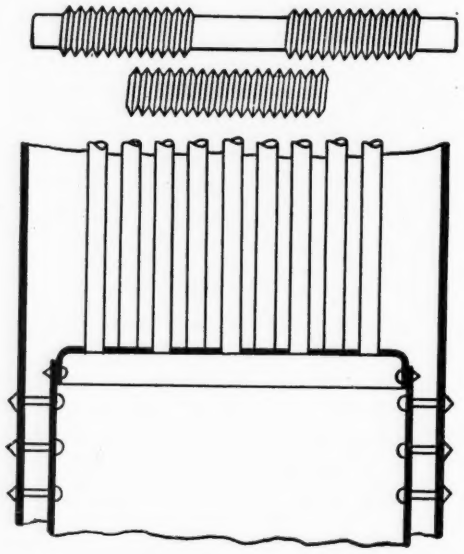


FIG. 2. TYPES OF STAY BOLTS AND THEIR LOCATION

corrosive action referred to. Their effectiveness has always been questionable.

Undoubtedly, the simplest type of brace is the diagonal or crow foot, as shown in Fig. 3.

Formerly, this brace was made of wrought iron, round in cross section, welded to make up the required length, when over 36 in. long. This welding of a brace has always introduced an uncertain element in the make up of the brace.

A few years ago, several of the leading steel concerns placed on the market a very superior crow foot brace, which is formed from the sheet in the desired shape and the required length.

When a boiler is held by crow foot braces, the head can be correctly supported and yet allow the maximum of room in the boiler for inspection, cleaning and repairs.

The diagonal brace as shown in Fig. 3 is attached to the head and the shell by 2 rivets in each end. Care should be taken to see that the combined area of the rivets fully equals the cross section of the body of the brace. It should also be noted that the cross sectional area of the heads of the brace, after punching the rivet holes, b Fig. 3, is fully equal to the cross section of the body of the brace, as seen in Fig. 3 at C. This is necessary because the whole is no stronger than its weakest part.

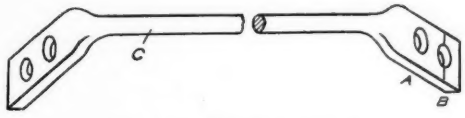


FIG. 3. DIAGONAL BRACE

Since the diagonal brace is run on an angle, its holding power is less than a head to head, or direct brace, as it is sometimes called, of the same area, because when running at an agle its axis is at an angle to the line of strain. For this reason, diagonal braces

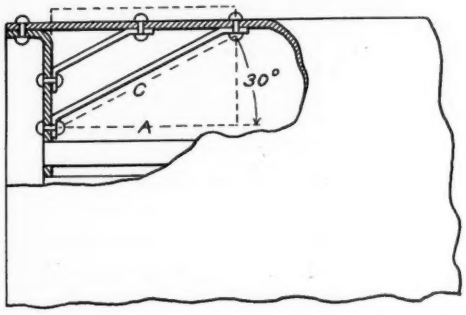


FIG. 4. BRACES RUNNING ON SAME ANGLE REGARDLESS OF THEIR LENGTH

are run on a very slight angle, usually at about 30 deg. to the horizontal, regardless of their length, as in Fig. 4. This simply means that to support a given load, a greater cross sectional area is required by a diagonal brace than when a direct brace is used under the same conditions.

When the heads are supported by braces running from head to head, the braces run parallel to the line of strain, and are considered by some preferable to the diagonal brace, although the interior of the boiler is more difficult of access.

The term through braces is correctly used only when the brace passes through each head, as shown in Fig. 5. In this case the ends of the brace are threaded, and pass through the heads. On the inside and outside of the head, a heavy nut and washer make the joint on the head, and take the strain.

The head to head brace is used in some constructions. In this case channel or angle irons are riveted to the boiler head, and the brace has a forked jaw on each end. One side of the angle or tee iron is inserted into the jaw of the brace and secured by a pin, although bolts are sometimes used and are to be preferred. Figure 5 shows the construction.

It can be seen that the area of the jaws of the brace and the area of the bolt on the pin securing the brace to the head should be the same as that of the body of the brace.

The flat crown sheet in locomotive boilers is usually supported by crown bars and sling stays. These are constructed as in Fig. 6. Two side pieces of the shape shown, are held apart by distance pieces and riveted together. The side pieces rest on the edge of the vertical side sheets of the furnace. To the distance pieces links are secured and are bolted at the other ends to angle iron riveted to the shell of the boiler.

Through the space between the side pieces, and through the crown sheet, long studs or bolts extend and thus support the flat surface of the crown sheet.

Another method of bracing boiler heads, in connection with 1 of the other types of braces, is by means of channel, angle or tee irons.

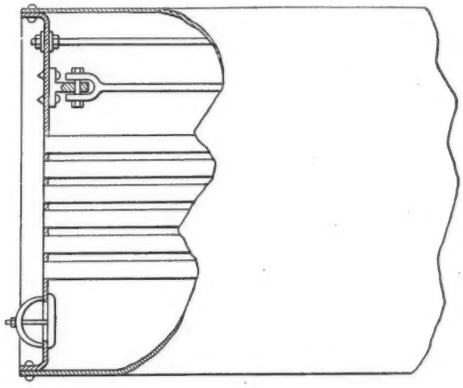


FIG. 5. THROUGH BRACE AND HEAD TO HEAD BRACE

The way in which these angles support the head is this: suppose that a strip of metal of given cross sectional area is securely held at the ends as in Fig. 7, and a load applied at the center. For the first inch away from the support the tendency to bend the metal is very little. At each succeeding inch toward the center, the tendency to bend increases, until the center is reached, where the deflection is the greatest. This is because the distance from the point of support to that where the weight is applied acts as a lever with increasing movement or travel.

When the channel iron is riveted to the head it practically increases the thickness of the head, and thus increases its resistance to bending or bulging under the same strain. The strain is carried nearer to the point of support and this means that the leverage is reduced, hence the amount of bulging is also reduced.

In the case of a boiler head, the flange of the head can carry the load for 3 in. from itself toward the

center so that 2 or 3 in. more will have little movement, making the channel-iron length about 6 in. less than the chord of the boiler head at the position of attachment. The strain is thus carried by the channel iron to the rivets.

The tubes possess sufficient staying or holding power to care for that part of the head they occupy and for 2 in. in all directions from the outside tube in each row.

Calculations

As previously stated, the flange of the head will support the head for a distance of 3 in. toward the

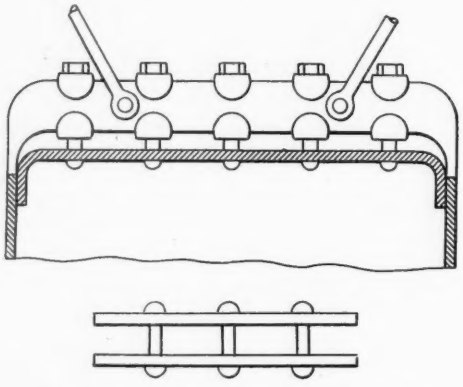


FIG. 7. CROWN BARS AND SLING STAYS

center; and the tubes will take care of 2 in. from themselves in all directions toward the flange of the head.

Suppose that we have a boiler 72 in. in diameter, and with the height from the top of the top row of

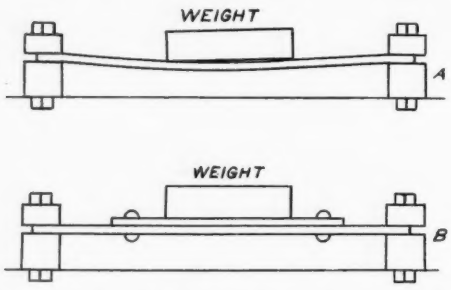


FIG. 7. ILLUSTRATING THE STIFFENING EFFECT OF CHANNEL IRON

tubes to the shell 27 in. Steam pressure to be carried is 125 lb. How many diagonal braces, each of 1 sq. in. cross sectional area, will be required?

To find this it is necessary to get the number of square inches to be braced, and that times the steam pressure will equal the total load on the braces.

The height from the top of the tubes to the shell is 27 in. From this we subtract 5 in. because the flange of the head and the tubes support it. This makes 27—5=22 in. as the height to be used in the calculation. One of the most accurate rules to find the area of the segment to be supported is this: Square the height from the top of the tubes to the shell, and multiply it by 4. Divide the last product by 3, calling this number (1). Next divide the diameter of the boiler head to be stayed, by the height from the top of the tubes to the shell. From this quotient subtract 0.608 and extract the square root of the remainder. Then multiply the square root so found by number (1) and the result will be the required area.

In working out an example remember that the flange of the head supports 3 in. of the head. The tubes also carry 2 in. So that the height above the tubes to the shell minus 5 in. is the height to be used in figuring. Likewise the diameter referred to, is the diameter of the boiler minus 6 in. because the flange of the head supports 3 in. all around the head.

TABLE I. AREA OF SEGMENTS OF CIRCLES

Q	Area	Q	Area	Q	Area	Q	Area
0.100	0.0409	0.205	0.1158	0.305	0.2028	0.405	0.2983
0.105	0.0439	0.210	0.1199	0.310	0.2074	0.410	0.3032
0.110	0.0470	0.215	0.1240	0.315	0.2120	0.415	0.3081
0.115	0.0502	0.220	0.1281	0.320	0.2167	0.420	0.3130
0.120	0.0534	0.225	0.1323	0.325	0.2213	0.425	0.3180
0.125	0.0567	0.230	0.1365	0.330	0.2260	0.430	0.3229
0.130	0.0600	0.235	0.1407	0.335	0.2307	0.435	0.3279
0.135	0.0634	0.240	0.1449	0.340	0.2355	0.440	0.3328
0.140	0.0668	0.245	0.1492	0.345	0.2402	0.445	0.3378
0.145	0.0703	0.250	0.1536	0.350	0.2450	0.450	0.3428
0.150	0.0739	0.255	0.1579	0.355	0.2498	0.455	0.3478
0.155	0.0775	0.260	0.1623	0.360	0.2546	0.460	0.3527
0.160	0.0811	0.265	0.1667	0.365	0.2594	0.465	0.3577
0.165	0.0848	0.270	0.1711	0.370	0.2642	0.470	0.3627
0.170	0.0885	0.275	0.1755	0.375	0.2690	0.475	0.3677
0.175	0 0923	0.280	0.1800	0.380	0.2739	0.480	0.3727
0.180	0.0961	0.285	0.1845	0.385	0.2787	0.485	9.3777
0.185	0.1000	0.290	0.1891	0.390	0.2836	0.490	0.3827
0.190	0.1039	0.295	0.1936	0.395	0.2885	0.495	0.3877
0.195	0.1078	0.300	0.1982	0.400	0.2934	0.500	0.3927
0.200	0.1118						

With this in mind, we will work out an example.

The height from the tubes to the shell is 27 in. less 5 which is already taken care of, equals 22. 22 squared and multiplied by 4 equals 1936, and 1936 divided by 3 equals 645. (1).

The diameter of the boiler is 72 in. which less 6 in. equals 66 in. the length of the diameter we figure on, and 22 in. is the height; 66 divided by 22 equals 3. 3 less 0.608=2.392. The square root of 2.392 equals 1.546. This is to be multiplied by (1), and 645 multiplied by 1.546=997.170, or in round numbers, 998 sq. in. that must be supported.

This rule is somewhat complicated, so the formula in the footnote is presented. In place of using the rule the area of the segment can be found from the above table:

To use the table, divide the height of the segment by the diameter of the boiler minus 6, and from table I, giving areas of segments, find under the column headed Q, this quotient; the area of the segment will be found by multiplying the constant in the column headed

Footnote:

$$A = \frac{4\,h^2}{3}\sqrt{\frac{D}{h} - 0.608}$$

In which h=the height from the top row of tubes to the shell minus 5 in.

D=the diameter of the boiler minus 6 in. 0.608=a constant. A=area of segment.

area by the square of the diameter of the segment circle.

Having found the area to be braced, this multiplied by the steam pressure will equal the load to be carried by the braces. In this case 998×125=124,750 lb.

Table II, gives the allowable strain per square inch for different diameters of braces.

As our braces are supposed to be mild steel without welds, conforming to modern practice, and as the area is specified as 1 sq. in. its diameter must be 1.125 in. Therefore in the second column of strains allowed, the second value 7500 lb. per square inch is the one that fits the example. Dividing 124,750 by 7500= 16.6 or in round numbers 17 for each head.

If a direct or through and through brace is used, simply divide by 8000 the allowable strain per square inch to find the number of braces required.

In many constructions, a combination of diagonal and direct braces is used. In laying out a combination, care must be taken to allow easy access to the interior of the boiler. A good combination is to use

TABLE II. ALLOWABLE STRESS IN BRACES

Material and Type.	Size up to and including 1¼" Diameter or Equivalent.	Size over 1¼" Diameter or Equivalent
Weldless mild steel, head to head or through stays,	8,000 lbs.	9,000 lbs.
Weldless mild steel, diagonal or crowfoot stays,	7,500 lbs.	8,000 lbs.
Wrought-iron weldless, head to head or through stays,	7,000 lbs.	7,500 lbs.
Wrought-iron weldless, diagonal or crowfoot stays	6,500 lbs.	7,000 lbs.
Mild steel or wrought-iron, welded stays,	6,000 lbs.	6,000 lbs.
Mild steel or wrought-iron, stay-bolts,	6,500 lbs.	7,000 lbs.

say 4 direct braces and the remainder diagonal, to carry the load.

Since 1 direct brace is allowed 8000 lb. per square inch area, 4 will carry 4×8000=32,000 lb. This subtracted from the total load gives 124,750—32,000= 92,750 lb. to be carried by the diagonals. 92,750÷7500 =12.3 or in round numbers 13 braces in each head.

The following rules may be found useful:

To find the area held by 1 stay divide the total area by the number of stays.

In the example taken the total area is 998 sq. in. and 17 braces are required in each head. 998÷17= 58.7 sq. in, held by 1 brace.

Since the diagonal brace runs on an angle, its holding power for a given area, compared to the direct brace, is reduced. To find the necessary area in a diagonal brace to carry the same load as a direct brace of a given area, it is necessary to multiply the area of the direct brace by the length of the diagonal brace, and divide by the distance from the head to the point of the shell where the diagonal brace is secured as shown in Fig. 4. C is the length of the brace and A the distance from the head to the attachment to the shell.

If the area of the direct brace is 1 sq. in. and the length of the diagonal 30 in. and the distance from the head to the shell 24 in., the required area will be, 1×30÷24=1.25 sq. in.

The area of a direct brace is found by dividing the area supported multiplied by the steam pressure, by the strain allowed on 1 brace multiplied by the number of braces.

If the area is 998 sq. in. and the pressure 125 lb. 998×125=124,750 lb. 8000 is the strain allowed on 1 brace and 15 the number of direct braces, 8000×15= 120,000. 124,750÷120,000=1+sq. in. area.

To find the pitch of the braces multiply the cross sectional area of the brace by the strain allowed per square inch, and divide by the steam pressure. Then extract the square root, which will equal the required pitch. 1×7500÷125=60. The square root of 60=7.74 or 7.75 in., the required pitch.

The pressure allowed on a bumped head Fig. 1, is found by multiplying 1/6 of the tensile strength of the plate by its thickness and dividing by 0.6 of the radius to which the head is bumped.

If the tensile strength is 58,000 lb. and the thickness of the plate is 9/16 in. and the radius to which the head is bumped is 42 in. the pressure allowed will be:

58,000÷6×9/16=5437.36; 42.×0.6=25.2, 5437.35÷ 25.2=213.3+lb.

ECONOMIZER IMPROVEMENTS

The large quantities of heat escaping in the waste gases from boilers and industrial furnaces, can be

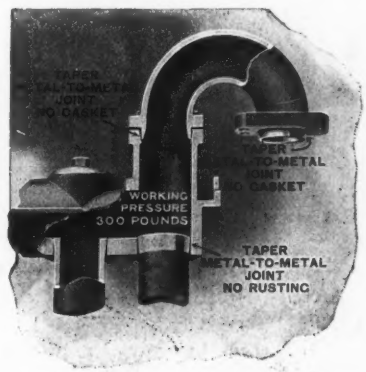


FIG. I. DETAILS OF METAL TO METAL JOINTS

readily imparted to the boiler feed water or to water used for any purpose about the plant by the installation of a suitable economizer in the flue.

By this means a saving of from 10 to 20 per cent in fuel is possible.

In the economizer here shown several improvements have been embodied.

The pipes are arranged vertically in staggered rows, which effectually break up the currents of heat passing to the chimney, and therefore take up a greater volume of heat than in some constructions.

All joints, between tubes, headers and manifolds, are made metal to metal. This is a great advantage, since there is no chance for the packing to blow out or leak.

The pipes are secured by taper fit into the several

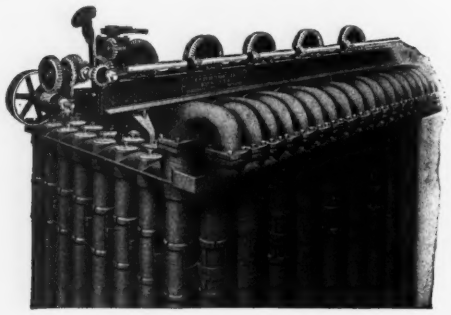


FIG. 2. RETURN BENDS IN POSITION

headers, or manifolds, and are tight under working pressures up to 300 lb. per sq. in.

The return bends of wall boxes are placed in communication with one another, which take up all expansion and contraction. Figures 1 and 2 illustrate

IMPROVED DRIVING HEADS ABSOLUTELY PREVENT THE SCRAPERS STICKING
PULLEY CAN BE PLACED AT RIGHT ANGLES TO THIS POSITION
ALL JOINTS METAL-TO-METAL; NOT A GASKET NO RUSTING
A PIPE, HEADER, OR MANIFOLD CAN BE REPLACED WITHOUT DISTURBING ANY OTHER PIPE, HEADER, OR MANIFOLD
CAN BE ARRANGED FOR FORCED CIRCULATION OR NATURAL CIRCULATION WITHOUT ADDITIONAL EXPENSE EVEN AFTER INSTALLATION
SCRAPERS MOVING CONSTANTLY UP AND DOWN REMOVE ALL SOOT
PIPES ARE ARRANGED STAGGERED TO MORE EFFECTIVELY REMOVE HEAT FROM GASES

FIG. 3. END VIEW OF ECONOMIZER WITH SCRAPER DRIVE

this return bend. The taper nipple enters a recess made in the header nozzle for its reception, when the whole is securely bolted together. The method of making pipe joints is also shown in Fig. 1.

Another improvement in this economizer is in the scraper drive, which prevents all sticking of the scrapers, and is shown mounted on the apparatus in Fig. 3.

The B. F. Sturtevant Co., Hyde Park, Mass., make this apparatus.

WHAT THE NAME "ALBANY" MEANS

Forty years ago, Adam Cook established in the city of Albany, N. Y., The Albany Lubricating Compound and Cup Co., for the manufacture of Albany grease and specialties in oils and lubricators.

Now for 17 years the entire manufacture of these products has been in the hands of Adam Cook's Sons of New York, a firm which is composed of the sons of Adam Cook the originator of Albany grease. This name Albany in a lubricant means that its makers have sought to produce an article above the common and have given their highest skill to its making. It also means that years of experience are behind the perfecting of it.

Adam Cook's sons now occupy 2 large buildings located at 313 West St., and 520 Washington St., New York City which indicates the tremendous increase in business and the great increase in demand since the founder started the Albany in a "hole in the wall."

Albany products are adapted to all kinds of machinery in all climates and are always correctly branded for various uses. The trade mark and also the word Albany carry the makers guarantee of this and are registered in all countries. They are associated with the first lubricating grease put upon the market, and stand as always for economy, and the certainty of keeping an engineer out of hot box troubles. The firm of Adam Cook's Sons attributes the magnitude of its business to the great care which has continually been exercised in the manufacture of its products, and in a great measure to the assistance of advertising. The firm has used large amounts of space in conspicious positions in prominent journals such as the Practical Engineer and other publications which reach the engineering profession everywhere. The company has also arranged by continual enterprise so that Albany grease can now be had from dealers and supply houses for hardware oil and auto supplies in every country, which is, of course, a great advantage.

RECEIVER PRESSURE REGULATOR

In plants where steam is used exclusively for power for manufacturing, the compound type of engine gives best results. If the demand for steam for other than power uses exists this type can be used to advantage except in cases where the same volume of low pressure steam is demanded as would be exhausted from a simple engine under the same load conditions. In ordinary practice the average of the two extreme conditions is met. In such cases the proper thing is to take the required volume of low-pressure steam from the compound engine receiver, the remaining volume passing to the low-pressure cylinder as usual. The ratio of cylinders is determined by the builder,

when the average percent of steam exhausted from the high is utilized in the low-pressure cylinder.

Since the amount of steam taken from the receiver is variable, the receiver pressure will also vary, if the cutoff in the low-pressure is constant. As the practise of taking steam from the receiver extends the desirability of maintaining the receiver pressure constant is apparent.

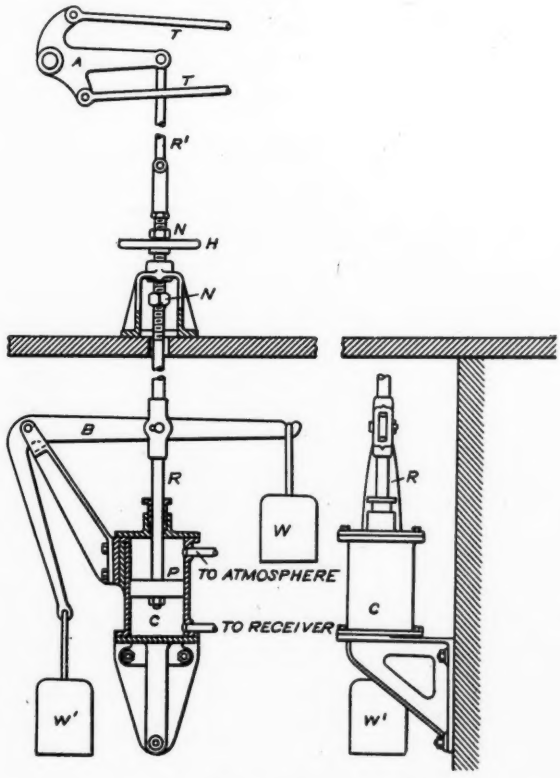


FIG. I. RECEIVER PRESSURE REGULATOR

Adjusting the low-pressure cutoff by hand, to proportion the load equally between the cylinders, is unsatisfactory and requires close attention. To overcome this difficulty and maintain a constant receiver pressure, Chas. T. Main, of Boston, Mass., has patented the regulator here described.

Its construction is as follows: In a convenient position the cylinder C is secured in which the piston P travels. The receiver pressure enters the cylinder under the piston as shown. The upper portion of the cylinder is in commmunication with the air. The piston rods R and R^1 are attached to the arm A and thus moves the knock off rods T T of the valve gear. To the arm R is connected the arm B, and on this 2 weights W W^1 are hung. When the receiver pressure increases, it raises the piston P, rod R R^1 and bell crank A, moving knock off rods T T, increasing the cutoff in the low-pressure cylinder and thus lowering the receiver pressure.

The weight W determines the lowest pressure to be maintained in the receiver, and weight W^1 as it swings to the right balances the variable pressure from the shortest cutoff to taking steam full stroke in the low pressure cylinder.

The hand wheel H is used to secure long cutoff in the low-pressure cylinder when starting the engine; also to fix the minimum cutoff when it is desired to run with fixed cutoff. Nuts N N can be set to limit the range of cutoff.

THE BERRY FEED-WATER REGULATOR

Recently the Berry Engineering Company, of Chester, Pa., has issued a new catalog describing its safety automatic feed-water regulator. This apparatus is particularly interesting because it meets all of the

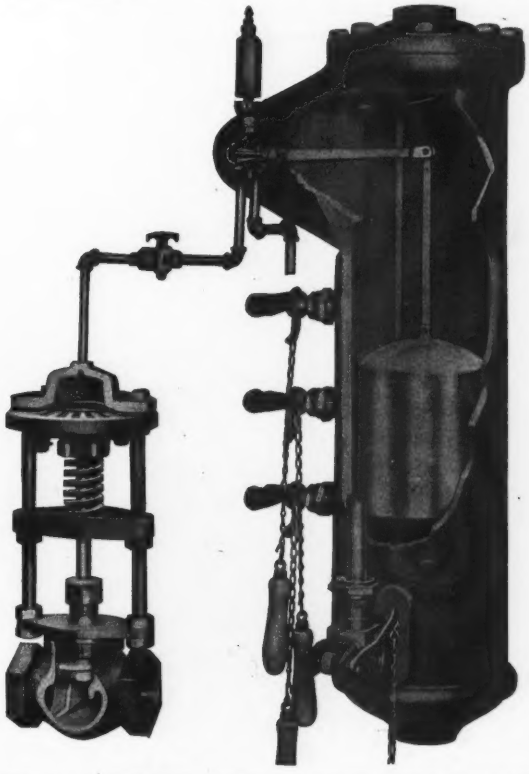


FIG. I. REGULATOR COMPLETE WITH BERRY COLUMN FIXTURES

requirements of a device designed to insure a uniform water level; namely, strength, durability, reliability, warning notice of any unusual happening, accessibility for inspection or repair, and means of adjusting the level at which it is desired to carry the water, while the machine is in service.

This regulating device is combined with the usual water column and high and low-water alarm, thus making necessary only 1 machine on the boiler. A seamless copper float responds to the variation in the water level of the boiler, and furnishes ample power to rotate the pilot valve through a simple lever. It is the office of the pilot valve to direct steam to the feed or control valve through the ⅛-in. brass pipe; or to the whistle for high and low water alarm.

The operation is dependent upon gravity alone, and special means are employed to make this positive and sure. First, the column is provided with internal longitudinal ribs which serve to guide the float, to insure against sticking, and to prevent the float from interfering with the operation of the gage and try cocks. Again, there being only 3 moving parts employed, the construction is the simplest possible.

The floats are subjected to a special process whereby they become absolutely non-collapsible under steam pressure, and are made light and buoyant enough to insure positive operation under all conditions, and at the same time strong enough to be proof against collapse and leakage.

The feed or control valve is made fully as strong and sensitive as the regulator itself. The valve is

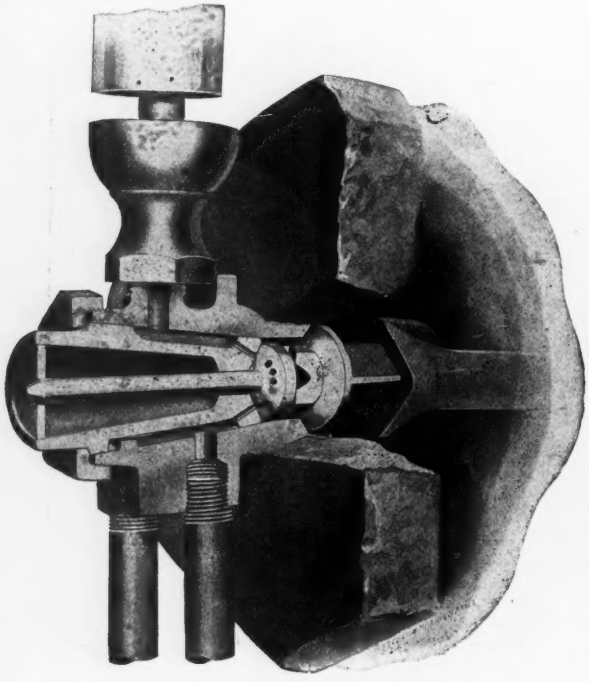


FIG. 2. SECTIONAL VIEW OF BERRY PILOT VALVE

always wide open or tight shut, and does not wear from wire drawing; and the diaphragm is supported by a flexible ring of steel plates which relieve the rubber of all strain, and make it practically indestructible.

The pilot valve embodies all the mechanism that can require cleaning or regrinding, and is so constructed that the valve and its seat can be removed for inspection and cleaning while steam is on the boiler and while the column remains in service showing the water level in the glass. This can be done with absolute safety, and the construction renders it impossible to replace these parts in the wrong position, or in other words, it is practically fool proof.

The action of this valve may be understood by reference to the diagram and to the cut showing in section the position of the valve when the water is at the level of the center gauge cock. When the nut 8 is about half way removed, the internal valve 14 will close, and the plug 7 and valve seat 5 can then be safely taken out. The internal valve stem 14 engages the pilot valve stem 5, and these parts rotate with the variations in the water level, the plug 7 remaining stationary.

A slight rise in the water above the set level will bring steam to pressure port B, and at the same time

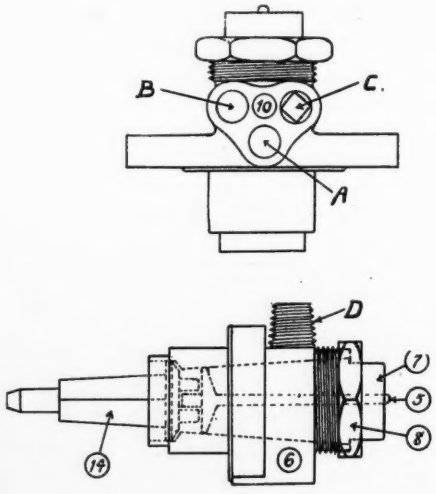


FIG. 3. BOTTOM VIEW AND SIDE VIEW OF PILOT VALVE

connect pressure port C with exhaust port A. Similarly a lowering of the water level will bring pressure to port C and connect port B with exhaust port A. In normal operation the variation never exceeds ½ in., but if from any cause the water level should not be maintained, the steam would be directed to the whistle port D and the alarm will blow for either high or low water.

By turning the pilot valve plug 7 slightly to right or left, these operations are advanced or retarded and the water level thereby altered. It is seen that the action of this valve makes it possible for either rising or falling water level to bring pressure on the feed valve, and provides for control of all possible cases which may arise.

With the ordinary installation, where a number of boilers are fed from the same pump, a feed valve is placed in the individual feed line to each boiler, and closed by the operation of the regulator when the water rises above the desired level.

In single boiler installations, regulation can be obtained with a pump governor in the steam line to the pump; or if a belted pump is used, the control valve can be placed in a bypass from the delivery pipe to the suction, allowing the pump to run all the time; or a belt shifting device can be operated to start and stop the pump. This is often accomplished at a great

distance, the action being immediate in all cases, as the pipes are full of water.

While primarily intended for use with steam boilers, they have been installed to regulate the water level in hydraulic pressure reservoirs and are giving satisfaction in this as well as in many other special arrangements.

For adaptability, the regulators are made both right and left hand, and the try cocks are always under the horn, out of the way, and the gage glass stands conspicuously in front. This is of great value where otherwise the piping and connections would be awkward and difficult; and it also adds to the general appearance of the outfit which is an ornament to any boiler room.

While try cocks and gage glass fixtures are necessary to complete an outfit of this kind, they are not considered a part of the equipment, unless specially so stated. The Berry Engineering Company standard fixtures shown here are of the special style which can be removed for inspection while steam is on, and the column in service.

A NEW PIPE WRENCH

Engineers and steam fitters, who have experienced the usual troubles with wrenches containing cast parts, will gladly welcome the wrench here described.

The Rothweiler pipe wrench is made entirely of drop forgings, and contains only 1 spring of the spiral type. No rivets are used in the construction, therefore the renewel of the inserted jaw is only a minute's work.

The material used in the movable jaw is said to have a tensile strength of 65,000 lb. From the cut it will be seen that there are no loose parts to be lost, or get out of order. The adjustment is simple, giving a firm grip, with quick release, which facilitates rapid work.

FIG. I. THE ROTHWEILER IMPROVED PIPE WRENCH

This wrench can be extended to its fullest capacity without weakening it, as is the case with some constructions.

The wrench is light, strong and pleasing in appearance.

The Crescent Forgings Co., Oakmount, Pa., is the maker.

THE LINTON COMBINATION

This is a feed-water heater, purifier, oil separator, muffler, return tank and pump governor, all in one. Its success is assured and its value proved by use in a large number of buildings in New York, in sizes from 250 up to 3000 hp. The various functions of the combination are performed in different compartments which are arranged in series, thus giving it great compactness without making it inaccessible or inconvenient to keep in perfect condition.

Oil separation is one of the chief functions of the apparatus, a large section being devoted to purifying the steam before it comes in contact with the feed water. The area of the steam expansion chamber, where the velocity of the exhaust steam is reduced, is large, thus permitting the steam to strike the perforated plate at low velocity which breaks it up into small streams before it strikes the wire-mesh separating screens.

There are thus 3 separate methods of taking out the oil; first, by slowing down the steam and allowing the oil to drop to the bottom of the chamber, second by sending it through a perforated baffle plate, and third by passing it through a wire-mesh screen. Each one of these 3 devices used alone is effective and the 3 combined give practically absolute certainty of removal of all but the faintest trace of oil from the exhaust steam.

Between this chamber and the feed-water chamber is a perfectly tight diaphragm which prevents the liberated oil from ever coming in contact with the feed water.

In the upper part of the second compartment are the heating trays which by economical arrangement of space are made with an unusually large amount of surface in proportion to the capacity of the heater. In the course of the heating these trays act as depositories for the carbonates of lime, magnesia, etc., which may be contained in the water, thus getting out almost all of the scale-forming material.

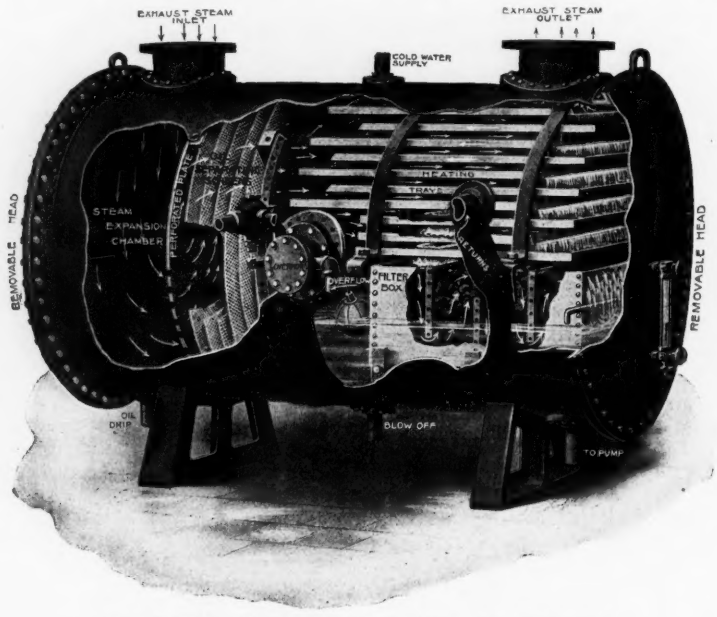
In the lower part of the feed-water compartment is the filter box which has large area so that the hot water percolates slowly up and down and through its entire length, ensuring the removal of any impurities that may have been retained after passing over the trays. Any good filtering substance, such as coke, may be used and the box being mounted on rollers allows of easy removal when it is necessary to renew the filtering material.

Controlled by a reinforced copper float, is the governor which has a sensitive balanced valve and may be arranged to regulate either the steam for the boiler feed pump or the cold water inlet to the heater, as desired. The apparatus may thus be set to have a constant feed to the boiler and keep the water level steady by regulating the inlet of cold water or it may be set to feed the boiler at variable speed, depending on the height of water in the receiver tank.

As the Linton combination is designed with large water storage, it is specially adapted for a receiver or return tank from a heating system. Return water may be carried to it from a heating or drying system and passed over the lower trays where it regains the few degrees temperature it has lost and is then passed

through the filter before mingling with pure hot water in the tank.

When it is necessary to clean out or repair the heater, the entire head can be removed without interfering with any pipe connections, thus giving a much better arrangement for the inspection, withdrawal of trays, and refilling of filter box, than is the case when only a small manhole is provided. The Linton combination is made by the Linton Machine Co., of New York City, in both horizontal and vertical styles, and can be adapted to local conditions of space and piping.



THE LINTON COMBINATION HEATER AND PURIFIER

Also, if so desired, it may be used as a muffler and oil separator in connection with a closed heater.

WINTERS VACUUM TRAP

Wherever there is likelihood of accumulation of water in an exhaust pipe on a condensing system, there is need of a vacuum steam trap to remove this condensation. The cause for accumulation of such condensation may exist in an uncovered steam pipe, backing up from the condenser, an oversupply of cooling water, or the water coming from the engine cylinder. The Winters vacuum trap is devised for automatically removing the water of condensation from a vacuum system, keeping the line free from water both before and after vacuum has been established. It will also remove oil and condensation from vacuum oil separators, and no steam connection of the trap is needed.

A sectional view of the trap is shown in Fig. 1, the body and one head being in a single casting and the other head bolted on. The inlet pipe connects to the upper side of the trap with a swinging check valve opening towards the trap and the lower part of the trap has an outlet with check valve that swings away from the trap. The exhaust pipe of the system is connected to the inlet pipe to the trap and the outlet pipe is led to a suitable point of discharge. On the upper part of the shell is arranged a valve chamber held in place by bolts and within this chamber is a bronze bushing carrying a piston valve. The valve chamber is provided with internal ports, A, that communicate with two sets of radial ports, B and C in the bushing. These ports A are in communication with pipes D and E, the former of which communicates with exhaust pipe or apparatus to be drained, and the latter with the atmosphere, in the form of an elbow joint, the opening being turned downward to prevent the entrance of dirt into the valve. The piston valve is driven by a stem F, which has on it 2 adjustable disks held against longitudinal movement by nuts; the movement of the valve is limited at 1 end by the end of the bushing and at the other by the head of the trap.

Near the bottom of the head is a bracket on which the float arm is riveted and near the middle of the head a second bracket on which is riveted a shaft which carries the operating mechanism for the trap. The float arm is connected by a link to a rocker, and this rocker by lost motion effect throws the hammer which strikes against the disks on the piston valve stem.

With the trap in the position shown, which is the one for the maximum volume of water, and when the hammer has just acted to throw the piston valve to the left, the port C is in communication with the air. In this position the air rushes in and destroys the vacuum, holding the inlet check valve to its seat and permitting the outlet valve to open by gravity, allowing the accumulated water to escape.

As soon as the ball float begins to lower by the falling of the water level, the rocker on the middle bracket will be moved so as to throw the hammer towards the right and, as soon as the hammer passes dead center, it falls to the right and strikes the right-

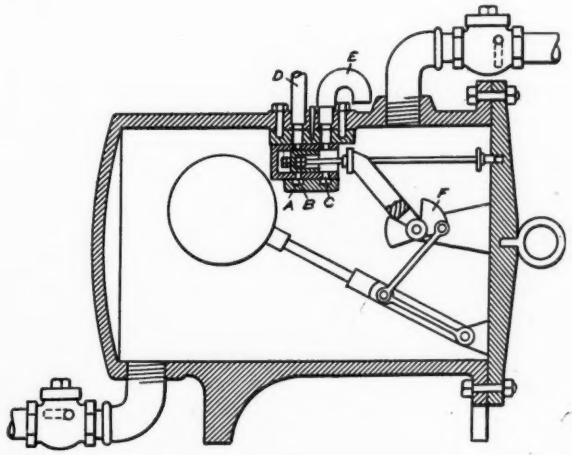


FIG. 1. SECTIONAL VIEW OF WINTERS VACUUM TRAP

hand disk a blow, throwing the piston valve to its right-hand position, thus closing the port C and opening port B to communication with pipe D. A vacuum is once more established, the inlet valve opened and

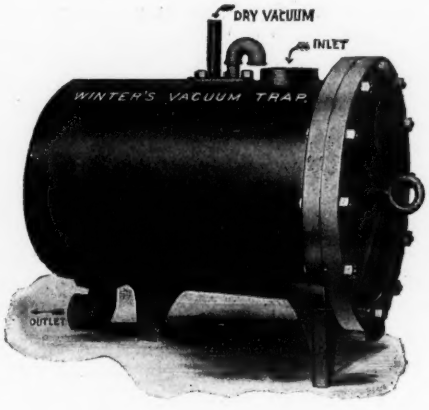


FIG. 2. WINTERS TRAP AS IT LOOKS IN USE

the outlet valve closed, and this condition is maintained until the float rises sufficiently to throw the hammer again to the left, destroying the vacuum and opening the trap for discharge.

The standard trap is made in 1 size, with 2-in. outlet and inlet, and when operated by gravity will discharge over 1400 gal. of water an hour. If desired, this capacity can be doubled by increasing the size of the inlet and outlet and using steam pressure to hasten the discharge. This trap is made by the Strong, Carlisle & Hammond Co., of Cleveland, Ohio.

GRAPHLIO. A NEW LUBRICANT

In the field of lubrication, a distinctly new development, which bids fair to go a long way towards solving many of the vexed questions, is a product just placed on the market by Walter D. Carpenter Co., of 39 Cortlandt St., New York City. This is known as Graphlio and is a graphite of absolutely pure crystaline flake form, free from grit, clay or other impurities, and ground to an impalpable powder.

This purity and fineness make it of inestimable value as an ingredient to mix with all grades of lubricating oils; it not only freely mixes with them, but remains mixed in suspension indefinitely.

For years, scientists and engineers have known that flake graphite possessed lubricating qualities much to be desired, and not found in any other mineral or vegetable product. It has been impossible however, to adopt it for many uses because of the difficulty of getting it in fine enough form, yet free from grit and impurities. Now comes the new form, Graphlio, which can be freely used, mixed with oil or other liquid, will stay mixed in can or oil cup, and will make the desirable qualities of graphite available for all places where a lubricant is required, with resulting reduction of friction and saving of power.

MECHANICAL "STOKING" FOR BITUMINOUS COAL

The Reagan Grate Bar Co., of Philadelphia has a new device for mechanically stoking bituminous coal

FIG. 1. THE REAGAN STOKING GRATE AT REST

which is constructed to obviate the use of the stoker bar and permits of the fire being uniformly stoked without the opening of the fire doors, thus saving labor and money, and eliminating the greatest hardship a fireman has to contend with, the slicing of fires with the stoker bar.

This stoking device is designed to keep the fire in a porous condition at all times, and its movement is such as will destroy clinkers in their infancy thereby permitting a continuous supply of air through the fire with resulting perfect combustion.

Under the old condition, when the fire doors were opened to permit the stoker bar to enter, the cold air rushed in and over the fire, retarding combustion, producing smoke, and reducing the temperature of the boiler furnace. Reagan's invention relieves these conditions, for by removing the stoker bar nine-tenths of

the labor trouble in the boiler room will be removed. The fact that the fire can be run continually without opening the fire doors to permit stoking the fire, results in a saving that the most inexperienced knowledge of combustion cannot but appreciate, and this saving in connection with the Reagan grate which carries a guarantee to evaporate 25 per cent more water per boiler than any other grate or stoker on the market under similar conditions or no money, is a proposition which meets with immediate response.

The construction of this stoking device is simple, consisting of a series of lifting firebars extending the entire length of the grate, spaced 18 in. apart across the entire width of the grate. Its use is not confined to the function of stoking fires alone, but when not in action it is part of the grate and like the other parts, it is air-cooled and durable.

Means for actuating the stoker sections are attached to the shaker which operates the choppers, but its movement is absolutely independent of the choppers, although if desired, it can be operated in connection with them.

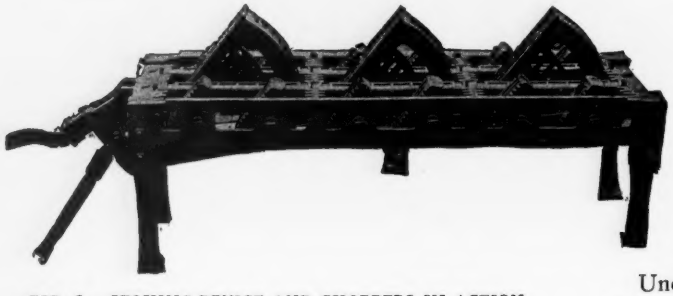


FIG. 2. STOKING DEVICE AND CHOPPERS IN ACTION

A TWENTIETH CENTURY PRODUCT

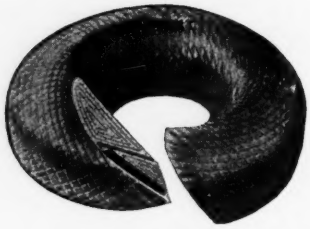
Early steam engines seem, in the light of our present knowledge, pitifully weak and inefficient.

The first successfully used for industrial purposes were employed to pump water from the coal mines of England. In these, the power was obtained by condensing steam at atmospheric pressure in the cylinder, the piston being sucked down by the partial vacuum thus formed. The cylinders for such engines were very large and built out of wood, hooped with iron bands, and these wooden cylinders were quite strong enough, since the pressure or suction seldom exceeded 10 pounds per sq. in.

The packing used in those simple days was merely such fibrous materials as came to hand, flax being preferred as more durable than other materials. Such packing did very well then, and even in later days when pressures were less than 30 pounds per sq. in. and the steam was more or less wet, the use of such packing was reasonable and proper.

Then there came a stage as the pressures crept from 30 up to 150 lb. when various woven and built up vegetable fibre packings were tried and found fairly satisfactory. A majority perhaps of the steam engines of the country are still in this class, and can still use a good flax packing with satisfaction and success.

But the modern engine uses steam at 200 lb. pressure or more, and often superheated, so that the steam in the high-pressure cylinder is as dry as a bone. Under such conditions, vegetable fibre will dry out, char, refuse to stay tight, and, if neglected, score the rod. It is for such service that Belmont No. 50 High Pressure Steam Packing is designed. It is composed of long stock asbestos fibre woven into wedges, and these cemented together to form a square. To these are attached a back composed of a rubber compound that will not become brittle or disintegrate under the highest steam pressures. The whole is impregnated with a special lubricating compound mixed with Ceylon graphite, making a packing which is composed entirely of non-friction material.



Under gland pressure the surface of the wedges break apart and the stuffing box is filled with a series of inclined planes which prevent massing or hardening of the packing.

This packing is for any pressure over 100 lb., and is said to stand up under all conditions of high pressure, high temperature, and superheated steam. It is made by Clement Restein Co., Philadelphia, Pa.

NEWS NOTES

In arranging for shipment of exhibits to the Denver convention of engineers, arrangements have been made by the National Exhibitors' Association for transportation as follows: Freight should be prepaid to Denver and the packages marked care Duffy Storage & Moving Co., Denver, Col., putting the number of the booth in the lower left-hand corner of the shipping tag. The charge for handling these packages will be 20c per 100 lb. each way, the goods being put into the exhibit spaces. The minimum charge will be 50c each way. All exhibits are required to be in place in time for opening of the exhibit hall on Monday, Sept. 7.

Joseph Dixon Crucible Co., of Jersey City, N. J., has filed application for registry of the word "Flake," as a trade mark applied to Dixon graphite. The word was first used by that company to distinguish the thin, tough Ticonderoga material from the thicker form coming from Ceylon.

From Idaho comes the news that Abraham Adams has developed a new kind of wheat which has a stalk resembling corn, a berry 4 times the sizes of ordinary hard wheat and which will yield 200 bushels an acre. If this proves true, and the enormous yield holds good

for large plantings, will the result be cheaper flour, or less land in wheat, and will the great drain on the land quickly impoverish the soil? In any case, if it turns out fact, it is one of the most astounding results achieved by applied science in this astounding age.

ON FRIDAY, JULY 24, The American District Steam Co., of Lockport, N. Y., suffered the loss by fire of a portion of its Tonawanda plant, where is located its casing mill and foundry. Plans are made for rebuilding the burned portion on an enlarged scale which is to be of fireproof construction as nearly as may be. The company informs us that its business for the season will not be delayed on account of the fire. The loss is fully covered by insurance.

CIVIL SERVICE EXAMINATIONS will be held throughout the United States during the fall of 1908 for positions of Heating and Ventilating Draftsman, Engineer in the Indian Service, Local and Assistant Inspector of Boilers, application for information in regard to which can be obtained by writing to the U. S. Civil Service Commission, Washington, D. C., or the Secretary of the Board of Examiners, at the postoffice in Boston, Mass., Philadelphia, Pa., Atlanta, Ga., Cincinnati, Ohio, Chicago, Ill., St. Paul, Minn., Denver, Col., San Francisco, Cal., or the Custom House in New York, N. Y., New Orleans, La., or the old Custom House, St. Louis, Mo.

FOR THE SECOND TIME in 3 years the refining building, known as Building No. 3, of the F. S. Walton Co., of Philadelphia, has been completely destroyed. The fire, which occurred on the morning of Aug. 15, consumed 20 tanks, containing about 10,000 gal. of pure neatsfoot oil. The total loss is estimated at between $25,000 and $30,000, partially covered by insurance.

By the time this announcement appears a new building will be nearing completion, if not already finished, as workmen were started clearing away the debris as soon as the ruins were sufficiently cooled to permit operations, the building being one of great importance in the manufacture of the company's product. As the new structure will be an exact duplicate of the building burned, no new plans were necessary, it having been demonstrated that the arrangement of size, 2 stories, 75 by 30, ft. and equipment, were as perfect as could possibly be secured.

THE HILL CLUTCH COMPANY, Cleveland, Ohio, recently received an order from 1 of the subsidiary companies of the U. S. Steel Corporation for 59 friction clutch pulleys.

All of these pulleys are to be 1 size and fitted with the new 1908 positive action Hill clutch, which was chosen by the purchaser after a competitive test was made upon a number of the various makes of clutches.

HEREAFTER THE Pittsburg Office and warehouse of the Chapman Valve Mfg. Co., will be at 47 Terminal Way, South Side, where a complete stock of its standard valves for all purposes and pressures will be carried. Herbert E. Stone is the Pittsburg representative.

THE NAME OF HARRIS TABOR is well known in the steam engine field in connection with his inventions. The Tabor indicator and the Tabor governor. Mr. Tabor was born in Clarence, N. Y. on Jan. 26, 1843 and from his boyhood was interested in engines and inventing. He went to the Hartford Steam Engine Co. in 1882 as superintendent and in 1883 moved to Pittsburg as superintendent of the Westinghouse Machine Co's. works, where he stayed for 2 years. He then opened office in New York city and devoted himself to the practice of consulting engineering and invention. He has been an active member of various societies, particularly the American Society of Mechanical Engineers.

On July 4, 1907 he was injured in an automobile accident and following that contracted a severe cold which with complications resulted in his death on July 29.

EVERYTHING POINTS TO A most successful convention at Denver. Manufacturers and dealers in power plant equipment are taking an active interest in the exhibits and the following list have engaged space up to the time of going to press:

Geo. W. Lord Co., Philadelphia, Pa.; G. M. Davis Regulator Co., Chicago, Ill.; Jos. T. Ryerson & Son, Chicago, Ill.; Nixon-Lancaster Eng. Co., Denver, Colo.; Arrow Boiler Compound Co., St. Louis, Mo.; Ashton Valve Co., Boston, Mass.; Strong-Carlisle & Hammond, Cleveland, Ohio; National Engineer, Chicago, Ill.; Hawk-Eye Compound Co., Chicago, Ill.; Pilley Packing & Flue Brush Mfg. Co., St. Louis, Mo.; Monarch Steam Blower Co., Troy, N. Y.; Garlock Packing Co., Palmyra, N. Y.; The Under Feed Stoker Co., Chicago, Ill.; Allis-Chalmers Co., Milwaukee, Wis.; The Denver Gas & Elec. Co., Denver, Colo.; McLeod & Henry Co., Troy, N. Y.; United States Graphite Co., Saginaw, Mich.; Dearborn Drug & Chemical Works, Chicago, Ill.; James McCrea & Co., Chicago, Ill.; Buckeye Engine Co., Salem, Ohio; Liberty Manufacturing Co., Pittsburg, Pa.; Peerless Rubber Mfg. Co., New York, N. Y.; The Lagonda Manufacturing Co., Springfield, Ohio; Hills-McCanna Co., Chicago, Ill.; Adam Cooks' Sons, New York, N. Y.; Home Rubber Co., Trenton, N. J.; Quaker City Rubber Co., Philadelphia, Pa.; Philip Carey Co., Cincinnati, Ohio; Westinghouse Mach Co., Chicago, Ill.; A. Leschen & Sons Rope Co., St. Louis, Mo.; The Westinghouse Air Brake Co., Pittsburgh, Pa.; Wm. Powell Co., Cincinnati, Ohio; F. S. Walton Co., Philadelphia, Pa.; The Stearns Roger Mfg. Co., Denver, Colo.; Kieley & Mueller, New York, N. Y.; Western Kieley Steam Specialty Co., Chicago, Ill.; The Mason Regulating Co., Boston, Mass.; Keystone Lubricating Co., Philadelphia, Pa.; Jenkins Bros., New York, N. Y.; Cling-Surface Co., Buffalo, N. Y.; Detroit Lubricator Co., Detroit, Mich.; Lunkenheimer Co., Cincinnati, Ohio; France Packing Co., Philadelphia, Pa.; Revere Rubber Co., Boston, Mass.; Crane Co., Chicago, Ill.; Southern Engineer, Atlanta, Ga.; Lyons Boiler Works, De Pere, Wis.; The Mining World Co., Chicago, Ill.; Practical Engineer, Chicago, Ill.; International Correspondence Schools, Scranton, Pa.; Michigan Lubricator Co., Detroit, Mich.; A. W. Chesterton Co., Boston, Mass.; Power, New York, N. Y.; Greene-Tweed Co., New York, N. Y.; American Steam Gauge & Valve Co., Boston, Mass.; Chapman Valve Mfg. Co., Indian Orchard, Mass.; Philadelphia Lubricator Co., Philadelphia, Pa.; D. T. Williams Valve Co., Cincinnati, Ohio; Mechanical Rubber Co., Cleveland, Ohio; Cancos Manufacturing Co., Philadelphia, Pa.; The Wright Manufacturing Co., Detroit, Mich.; The Austin Separator Co., Detroit, Mich.; Warren-Webster & Co., Camden, N. J.; Ridgway Dynamo & Engine Co., Ridgway, Pa.; Westinghouse Electric & Mfg. Co., Pittsburg, Pa.; Convention Committee, Board of Trade, Columbus, Ohio.

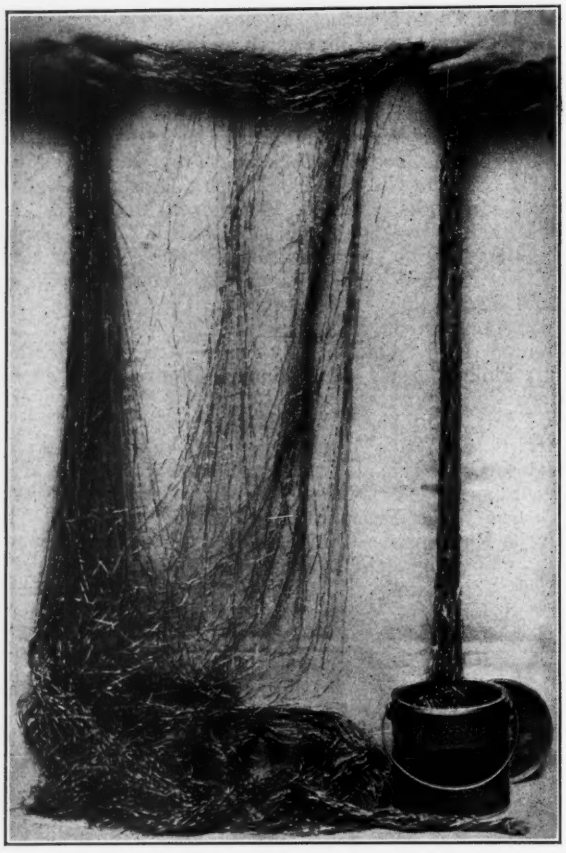
AT ITS RECENT CONVENTION at Put In Bay, Ohio, the Universal Craftsman Council of Engineers elected as officers: Grand worth chief, W. J. Ranton, Rochester; assistant grand worth chief, I. W. Gilbert, Buffalo; grand secretary, W. S. Cadwell, Chicago; grand treasurer, A. K. Young, Pittsburg; grand warden, Walter Prior, Newark, N. J.; grand guard, N. G. Carney, Toledo.

THE ENGINEERS' CLUB, of Philadelphia, has removed to 1317 Spruce St., to new and larger quarters.

A PRACTICAL METALLIC PACKING

For some time, engineers have felt the necessity for a packing that should be especially suited to the high pressures and high piston speeds of modern engines. To supply this need, inventors have properly turned their efforts toward the manufacture of a packing that shall be entirely metallic, or at least mineral in its composition. Ambest is such a packing, and has proved an entire success. It is composed of long pliable filaments of non-friction metal, treated with a special mineral lubricating compound.

In service, the parts next the rod wear to a smooth solidity, while away from the rod it retains its original fibrous condition.



Its advantages are summarized as follows: It fits any stuffing box; all sizes may be packed from the same can. It withstands the highest pressures and speeds. It has no rings or springs, and may be applied by anyone in a few minutes. It can be used over and over again. It requires no measurements. It needs no replacing, stands years of severe service. It prevents the scoring or cutting of rods. It stands 600 deg. F. and will not become hard, or melt and run out. It is a perfect ammonia packing.

Ambest is made by the Canfield Mfg. Co., of Philadelphia, Pa.

PERSONAL

T. H. WHEELHOUSE, formerly manager of the Cinnati office of the Westinghouse Machine Co., has recently become associated with the Hooven, Owens, Rentschler Co., of Hamilton, Ohio, which manufactures Hamilton-Corliss engines, and has taken charge of the Pittsburg territory, with offices in the Frick Building.

ON AUGUST 1, HERBERT SELF, who for several years represented the Crandall Packing Co., accepted a position with the Keystone Lubricating Co., of Philadelphia, and will represent it in the New York territory, with headquarters at its New York office, 96 Warren St. Mr. Self has an extensive acquaintance in the stationary engineering field and we wish him much success in his new connection.

CANADIAN ENGINEERS' CONVENTION

On August 11, 12 and 13, the Canadian Association of Stationary Engineers held its nineteenth annual convention in Windsor, Can.

Tuesday forenoon was taken up by the reception of delegates and an address of welcome by the mayor. In the afternoon a visit was made to the plant of Hiram Walker and Sons distillery, and in the evening a banquet was held in the British-American Hotel, at which a number of the members of the National associations Nos. 1 and 7 of Detroit, Mich. were the guests of the Canadian engineers.

On Wednesday afternoon, the Canadian engineers were the guests of the National Associations of Detroit, and were given an automobile ride around the city and a luncheon at Pfieffers' Gardens. They then boarded the Steamer Promise for a moonlight ride on the Detroit river as the guests of J. T. Wing of Detroit.

The convention closed Thursday morning to meet in London next year.

The following officers were elected:

President, C. Kelly, Chatham; vice-president, William McGhie, Toronto; secretary, William Crockett, Hamilton; treasurer, A. M. Wickin, Toronto; conductor, J. J. Heeg, Guelph; doorkeeper, W. Norris, London.

BOOKS AND BOOKLETS

ECONOMICAL USES OF BITUMINOUS COAL, LIGNITE AND PEAT as worked out in the suction gas producer is the title of a leaflet sent out by the Weber Gas Engine Co., of Kansas City, Mo. This booklet gives a general discussion of the different styles of producers and scrubbers and tests of different coals by fuel analysis, and the coal needed per horsepower hour when used with the suction producer and gas engine.

H. W. JOHNS-MANVILLE CO. is sending out two folders, one describing Point-Tite, a cement for making joints in tin or slate roofs where elasticity as well as tightness are needed; and the Gilbert gauge glass preservers, which is a device for saving glasses, patience and washers.

THE SQUEALING COMMUTATOR is a source of much annoyance even though it may be entirely free from sparking and arcing.

The Joseph Dixon Crucible Co., of Jersey City, N. J. reports that its graphite brushes, which are made in only 1 quality, are giving most excellent satisfaction. The company frankly acknowledges in its literature that a brush of 1 quality is not adapted to all conditions, but says that where its brushes are adapted they give unexcelled service.

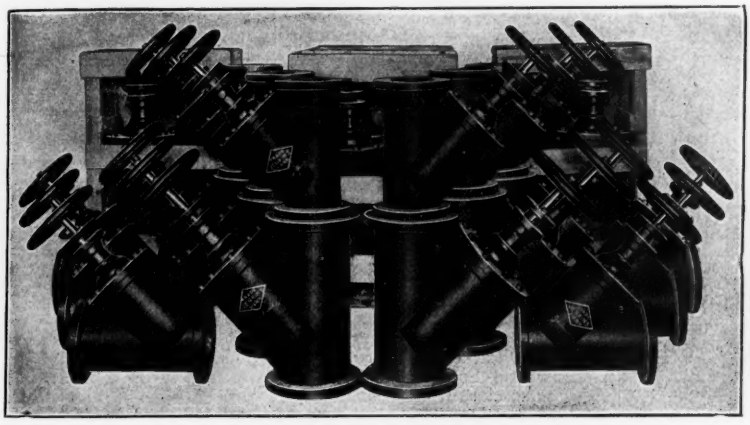
Their use results in the commutator taking on in a short time, a smooth, well rounded and highly polished surface. Since the installation of its own electric plant some 8 years ago, there has been no occasion

to turn down the commutators, and this is reasonably attributed to the condition of the commutator due to the use of their graphite brushes.

A concise little booklet of 12 pages is supplied to any and all who may be interested in commutation, and who will write to the Dixon Co. for it. Some incidental hints given in this booklet include information concerning the testing of brush pressure, and the filing of mica insulation. There are also some conclusions given as a result of tests made by Professor Albert F. Ganz of Steven's Institute.

TRADE NOTES

THE ACCOMPANYING PHOTOGRAPH gives a view of a group of Jenkins Bros. Y valves in sizes 6 and 8-in., being a part of an order recently shipped to a new plant, which when completed, will be one of the largest and most modern sugar refineries in the world. Various refineries throughout the country have been using valves of this type for years, with very good results. Jenkins Bros. Y valves are especially adapted for service in such plants, or any place where the passage of thick fluids is required. Moreover as blowoff valves they have no superior. as the seat is set at an angle of 45 deg., they offer but little resistance to the full flow of steam or any fluid, and have a full opening in line with the pipe. They are fitted with renewable seat rings and disks, so that the parts most subject to wear can be readily replaced when worn. These valves in brass are made in 2 patterns, viz: standard for ordinary pressures of steam, and extra heavy, for high pressures. Both types are extensively used, the latter being especially suitable for high-pressure boilers. Valves in iron body are made either screwed or flanged, with strong substantial bolted bonnets, known in the trade as Boston Hub. They are manufactured by Jenkins Bros., bear their name and trade mark, and can be purchased through any of the regular dealers.



THE H. W. JOHNS-MANVILLE CO., 100 William Street, New York, has recently put on the market the Success Portable Fire Extinguisher. It is made of extra heavy Lake Superior cold rolled copper, securely riveted and reinforced by heavy shoulders of solder, every one of which is tested to withstand a pressure of 350 lb. to the square inch, or 4 times the required strength. The joint where the cover is attached is ordinarily the weakest part, but the method of attaching the dome to the body of the shell is said to make that joint the strongest part in this extinguisher. The large wheel at the top of the machine is a convenience in opening and closing it, at the same time serving as a base on which to rest it when reversed, as in use for playing on a fire. The frame work, or bottle holder, containing the supply of sulphuric acid, is cast brass and virtually indestructible. The bottle of standard size and type for holding the acid is obtainable anywhere in case of accidental fracture from any cause. The hose tested to 400 lb. to the square inch, cannot be pulled off, and is only detachable with a wrench, being joined to the body by a swivel ground joint. The nozzle is said to be absolutely noncorrodible.

No mechanical force is needed to put the apparatus in action; it is simply turned bottom up and the resultant mixture of sulphuric acid in the 3 gallons of water charged with bicarbonate of soda, develops instantly, force enough to throw a chemical stream 50 ft. This chemical stream acts as a blanket and smothers fire which water cannot reach. By means of a lead stopper, fitting loosely, the flow of sulphuric acid is regulated, and just the correct amount of gas generated at all times, making explosion impossible, the company states. As this extinguisher neutralizes the acid before it leaves the machine, the stream will not injure material with which it may come in contact.

This extinguisher is included in the list of approved chemical extinguishers issued by the National Board of Fire Underwriters.

AMONG RECENT ORDERS TAKEN BY The Ohio Blower Co., Cleveland, Ohio, for Swartwout steam specialties, are the following: One 12-in. steam separator for Sloss Sheffield Steel & Iron Co., Florence, Ala., in addtion to a previous order for 3 10-in. separators; 1 10-in. separator for Lakeside Hospital, Cleveland, Ohio; an exhaust head, steam and oil separator for New York Central R. R. Shops; a 6-in. oil separator and exhaust head for Northern Electric Co., Newport, Wash.; 1 10-in., 1 8-in. and 4 other sizes of exhaust heads for John R. Keh Co., Battle Creek, Mich.; steam separators to Grand Trunk R. R. Shops, Battle Creek, Mich.; James Flood Building, San Francisco, Cal.; exhaust heads to Stillwater State Prison, Stillwater, Minn., and Brooklyn Union Gas Co., Brooklyn, N. Y.

AMONG THE BUILDINGS IN Chicago lighted by generators which are driven by Fleming-Harrisburg 4-valve engines are the Auditorium Theatre, the Con-

gress Hotel and Annex. The Fine Arts Building, Studebaker Theatre, University Hall, Great Northern Hotel, the New Hotel Brevoort, the Windermere and Vendome Hotels, Boston Oyster House, St. Luke's Hospital, and the Raymond Lead Co's. Factory.

THE PECULIAR EXCELLENCE of Ambest metallic as an ammonia packing is attested by the following letter, which was received unsolicited by Laib & Co., who are agents for Ambest in the state of Kentucky:

"After trying several of the most expensive and most highly recommended packings on our ammonia pumps and failing to get results from their use, we were induced by your Mr. Craft to give your Ambest packing a trial under a guarantee. We did so, but after our previous experience expected it to fail also, but we have been most agreeably surprised at the results obtained by its use, having used it for the past 2 months, and there has never been the trace of a leak, while our weekly expense heretofore for packing for these pumps was more than the initial expense of the Ambest, not to mention the loss from ammonia leakage. Very truly yours, Royal Spring Ice Co."

Free sample of Ambest, and further information concerning it, can be had from the Canfield Mfg. Co., Philadelphia.

AFTER SEPTEMBER, the main offices of the Bird-Archer Co. will occupy the twenty-second floor of the West Street Building, New York City. The new offices contain more than 4 times the floor of floor space made necessary by an unexpectedly large increase in business during the short time in which the company has occupied the present offices, certainly speaks well for Bird-Archer products and Bird-Archer business enterprise. It will interest progressive manufacturers to know that the Bird-Archer Co. did not recall its sales forces or retrench in any way during the recent business depression and that this continued activity resulted in a practically normal American trade and an export trade which continued brisk without interruption.

The demand for boiler compounds in the Orient especially seems to be promising as the Bird-Archer Co. now sends out its Asiatic shipments in 5-car lots. These are usually consigned to Pacific Coast agents who re-ship to the foreign agents and customers. P. B. Bird, president of the company, also expresses the opinion that American industry must be active in Cuba as the demand for its boiler compounds on the island has grown beyond all prophesies.

GOULD-COLUMBIA DEEP WELL PUMP, the Pressure hydraulic ram and Star yard hydrants manufactured by the Gould Manufacturing Co., of Seneca Falls, N. Y. are described and listed in a booklet recently received.

FROM THE JOSEPH DIXON CRUCIBLE CO. comes an attractive little booklet of envelope size entitled Dixon's Ticonderoga Flake Graphite, printed in 2 colors, black and red, a color scheme which is carried out on the cover by using a black cover stock and red ink for printing the seal cover design. Inside the matter is arranged by pages, each page dealing with some particular phase of the graphite subject. At the bottom of the page is given disinterested testimony bearing, whenever possible, on the particular phase treated on that page. Anyone who is interested in machinery of any sort will probably find in this booklet some matter to interest him. It is not lengthy, but some interesting and valuable information is given. Any of our readers desiring a copy of this new Dixon booklet may secure it by writing direct to the Dixon Co.

THE HESS-BRIGHT BALL BEARINGS are described and illustrated in the catalogue just out by the Hess-Bright Manufacturing Co. of Philadelphia.

WANTED

"Positions Wanted" advertisements not exceeding 50 words for subscribers to Practical Engineer will be inserted twice free of charge. "Help Wanted" and special advertisements 25 cents a line.

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PATENTS

Watson E. Coleman, Patent Attorney, Washington, D. C. Advice and books free. Highest references. Best services. 4 tf

WANTED

Engineers, Firemen, Electricians, Machinists, etc. New 25-page pamphlet containing questions asked by Examining Boards sent free upon request. Address, Geo. A. Zeller Book Co., 4467 W. Belle Place, St. Louis, Mo. Established 1870. 4 tf

ENGINEERS AND MECHANICS

to make big money selling Incomparable "Dozit" Hand Soap. A 10-cent can will instantly remove more dirt and stains from the hands than four cakes of any soap made, and it will not injure the most delicate skin. Small sample free. Byram Co., 225 Congress Street, Boston, Mass. 4 tf

FOR ENGINEERS

The new revised edition of the Modern Engineer's Hand Book. A $2.50 Book by mail on receipt of 50 cents. Be quick. Address, W. H. Ermentrout, 514 Elm Street, Reading, Pa. 4 tf

PATENTS

C. L. Parker, Late Examiner, U. S. Patent Office, Attorney-at-Law and Solicitor of Patents. Patents secured promptly and with special regard to the legal protection of the invention. Handbook for inventors sent upon request. 186 Dietz Bldg. Washington, D. C. 4 tf

FOR SALE

60 steel storage tanks, 6,000 gallons' capacity. Good as new. Double riveted, extra well built. Suitable for storage of oils, waters or liquids of any kind. 100 steam pumps. Get our prices on engines, boilers and electrical machinery. All sizes and kinds. Chicago House Wrecking Co., 35th and Iron Sts., Chicago. 4 tf

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We want a good Salesman in every city in the United States, to handle Ideal Metallic Packing. Manufacturers' Agents and Engineers preferred—Ideal Metallic Packing Co., South Stillwater, Minn. 4 tf

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As assistant in electric light plant. Graduate of I. C. S. electric lighting and engine running courses. Experienced in care and operation of storage batteries. About two years' experience in light plant work. Best references as to character and ability. Address Sam Frost, Odessa, Mo. 8-2